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Piscataqua Region Estuaries Partnership

Technical Advisory Committee Meeting
May 9 and 10, 2017

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Piscataqua Region Estuaries Partnership

PREP's Technical Advisory Committee Timeline (2016-2017)

9/29/16

Meeting 1: Kick-Off

- Nutrient Loading 1
- Nutrient Concentration 1, Dissolved Oxygen 1, Microalgae 1, Sediment Concentration 1

10/28/16

Meeting 2

- Macroalgae 1
- Eelgrass 1

1/6/17

Meeting 3

- Shellfish 1

March 28 / 2017

Meeting 4

- Nutrient Loading 2
- Nutrient Concentration 2; Dissolved Oxygen 2, Microalgae 2, Suspended Sediments 2

May 9-10 / 2017

Meeting 5

- Eelgrass 2, Macroalgae 2
- Relationships between indicators and other parameters

Goals for Tuesday and Wednesday Combined

- Committee understands purpose of new cross-cutting section on subtidal habitat quality for State of Our Estuaries Report
- Committee sees and discusses new data available for: precipitation, river discharge, light attenuation, turbidity, CDOM, salinity, water temperature
    - These data will be included in the new cross-cutting section and they impact the entire ecosystem, not just particular species
- Committee understands probability/impact matrix, which will be used as a tool over the next two days to think about eelgrass stressors
- Committee hears presentations from two different perspectives on eelgrass stressors
- Committee has opportunity to discuss and provide feedback on the stressors via the probability/impact matrix
- Committee has opportunity to reflect on how stressor discussion impacts the entire ecosystem. Not just eelgrass.

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Basic Agenda for Tuesday, May 9
(10 to 1:30 at Portsmouth Public Library)

- Discuss goals and context
- Discuss new cross-cutting section for SOOE report
- Review new data on precipitation, river discharge, etc.
- Hear from Fred Short regarding various eelgrass stressors
- Hear from the Municipal Coalition regarding various eelgrass stressors
- Discussion

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Basic Agenda for Wednesday, May 10 (9 to 12:30 at Dept. of Env. Services Coastal Office, Pease Tradeport)

- Recap from previous day. Re-introduce probability/impact matrix
  - Four step process:
    - Is it plausible that stressor is having an impact?
    - How probable?
    - How significant an impact?
    - How confident are we?

- Individual/Group work to prepare drafts of the matrix tool

- Share drafts and discuss

- Hear from External Advisors Jud Kenworthy, Ken Moore and Chris Gobler

- Discuss

- Hand in final matrix worksheets

Intertidal Seaweed

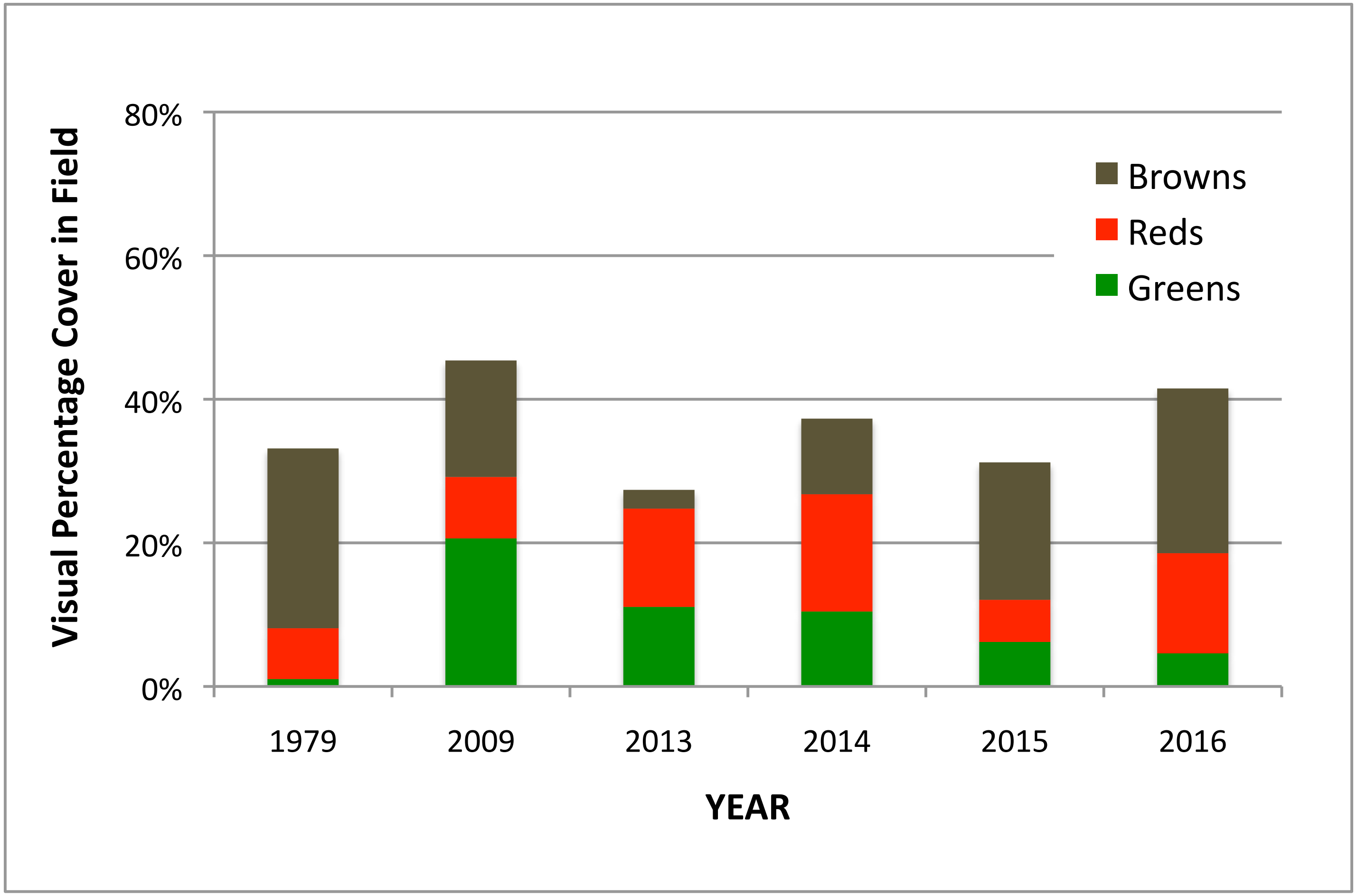


Figure 1. Intertidal percent cover of brown, red and green seaweeds for 2009-2016. Data were limited to collections at five sites within the Estuary in August and September from 0.0 m to 1.5 m above mean low tide (MLW). 2014 had data from only four sites. In 1979 data were collected in summer, fall and the following spring from 3 sites.

Precipitation

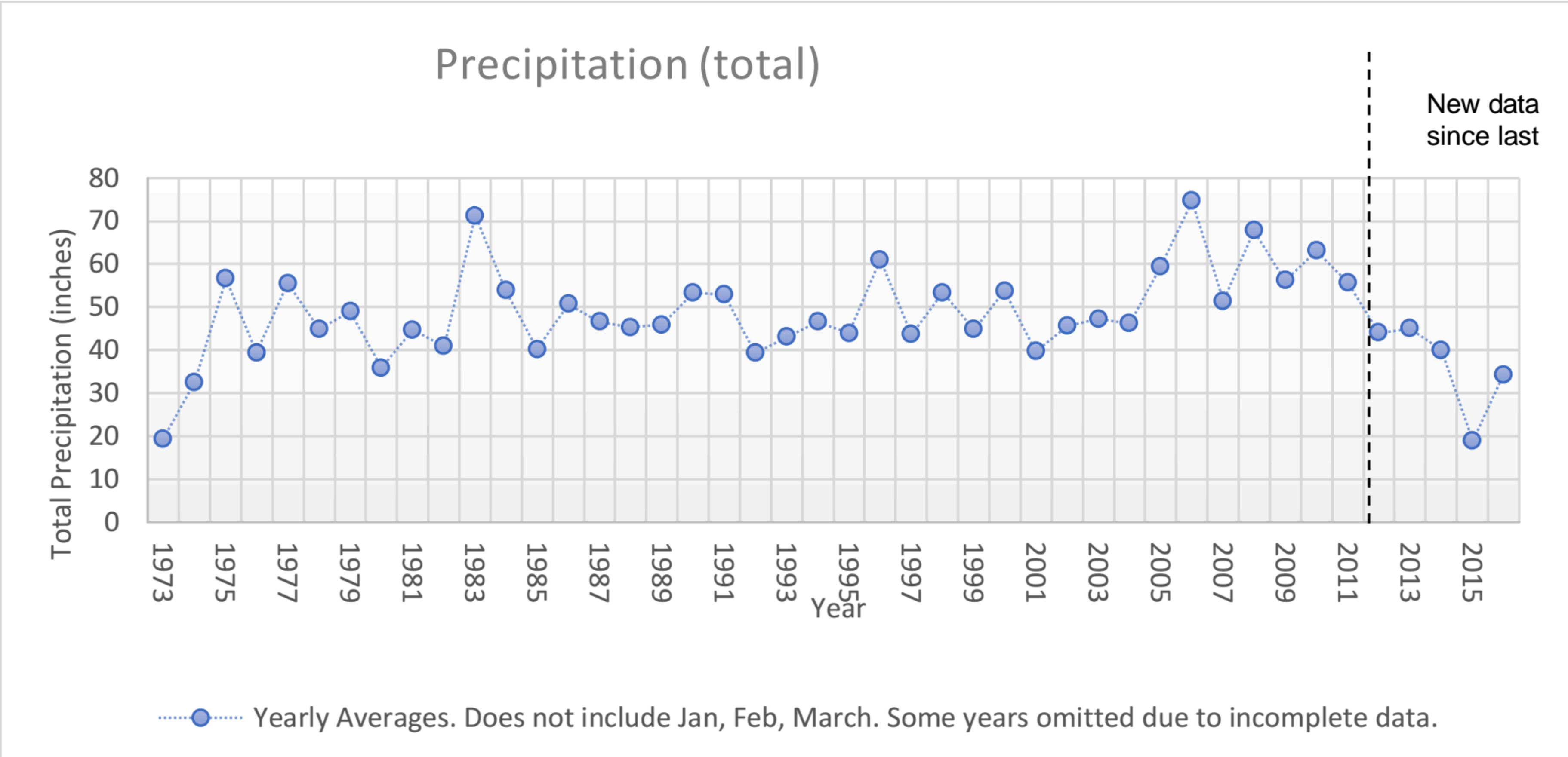
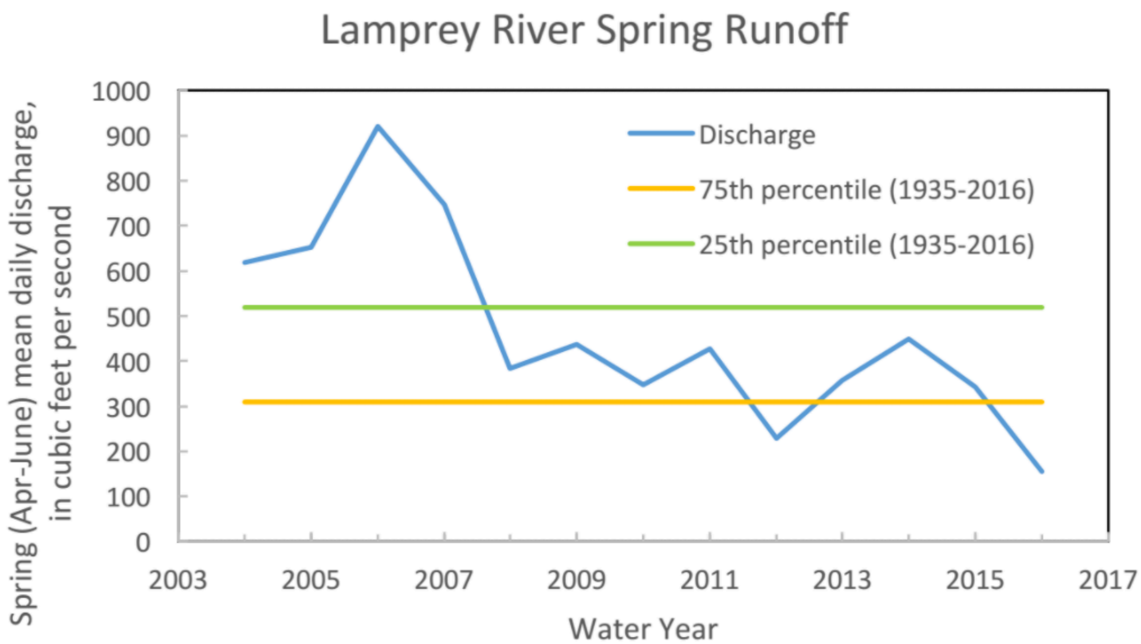
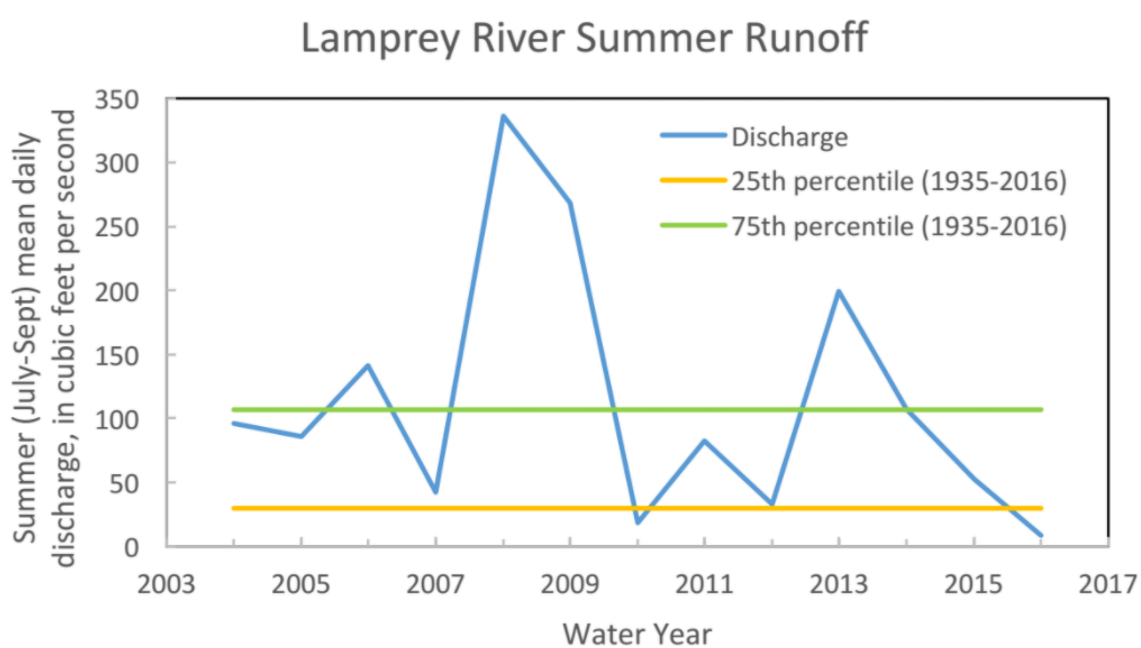


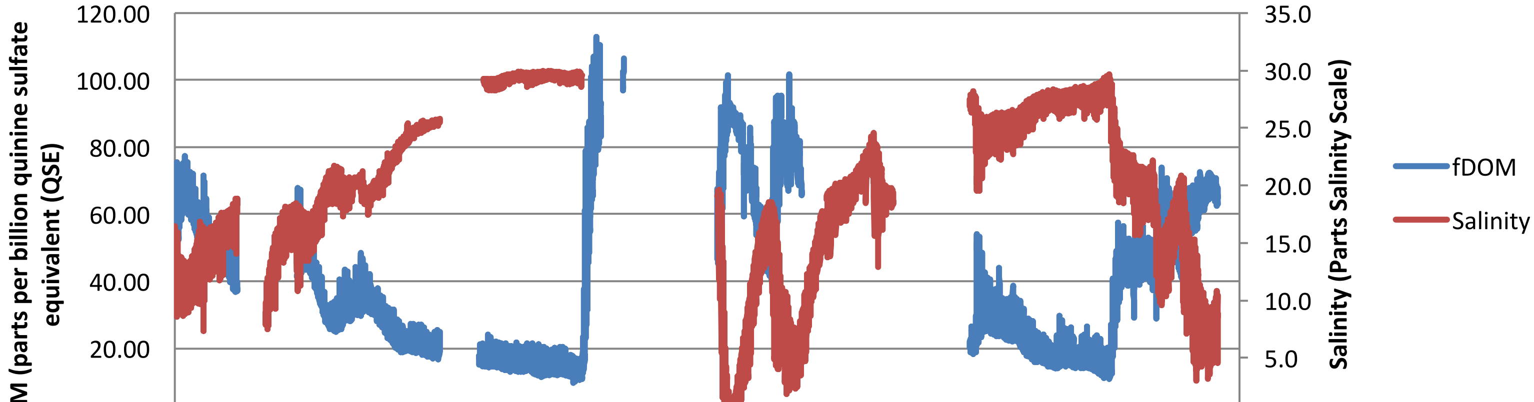
Figure 1. Total precipitation. Yearly averages based on daily total precipitation values taken at the Greenland, NH station.



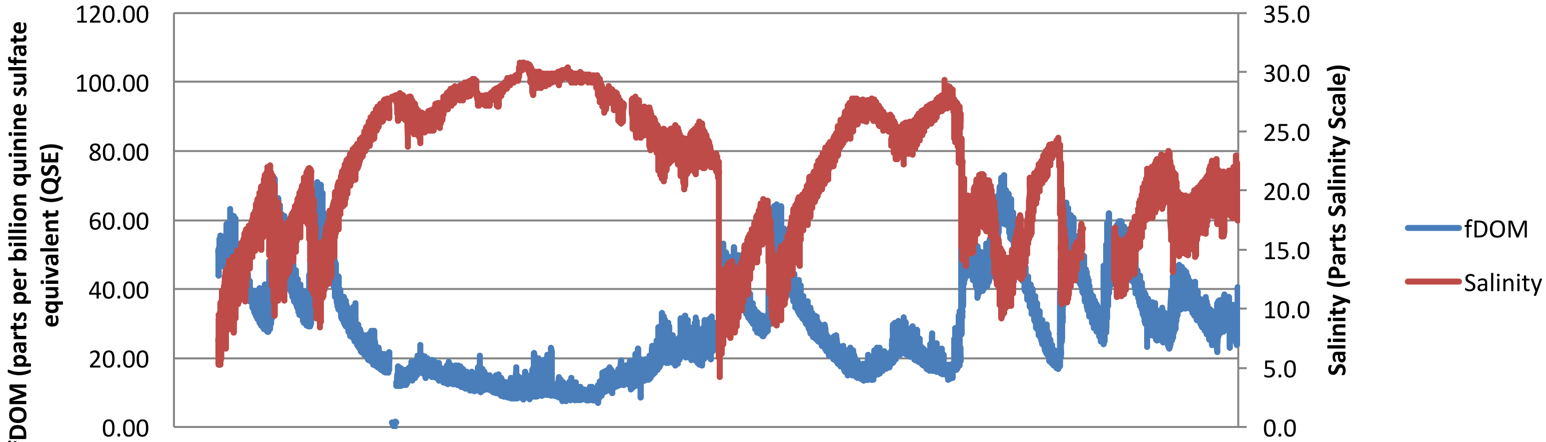


Spring (April-June) and Summer (July-September) mean daily discharge at USGS station 01073500 Lamprey River.

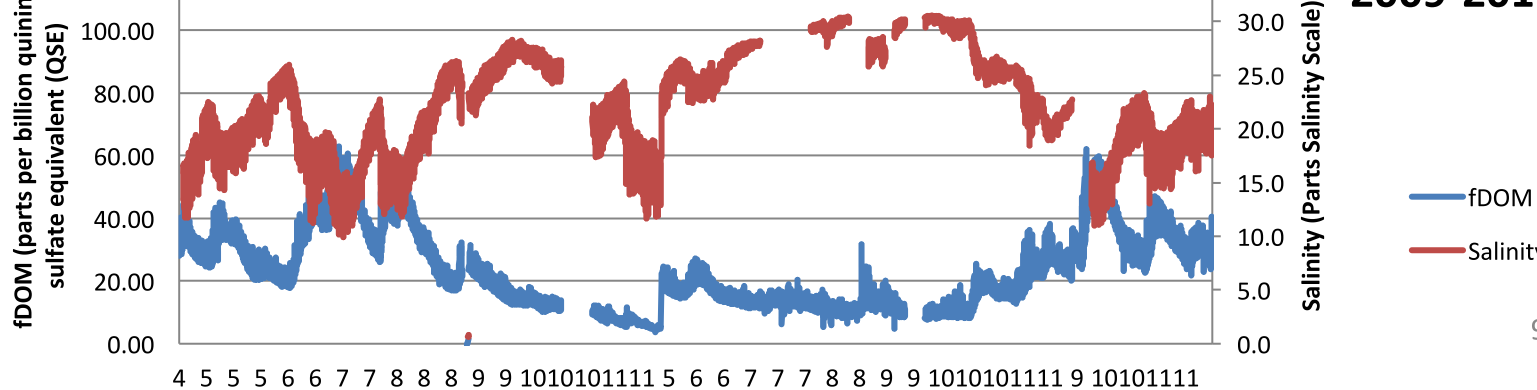
fDOM and Salinity 2005-2006



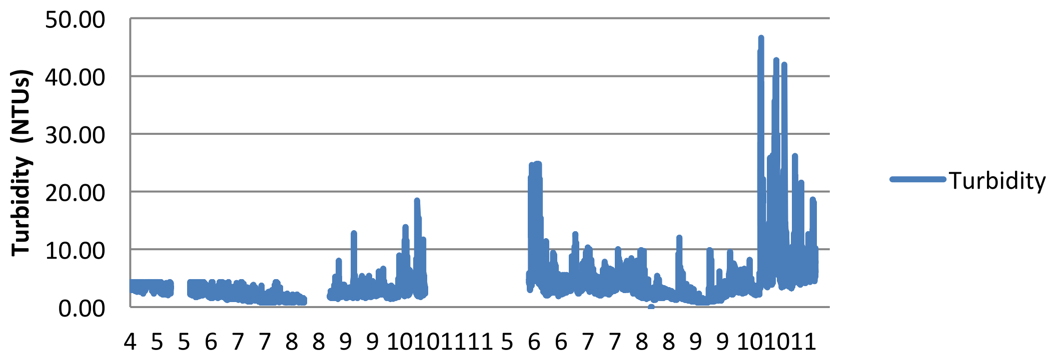
2007-2008



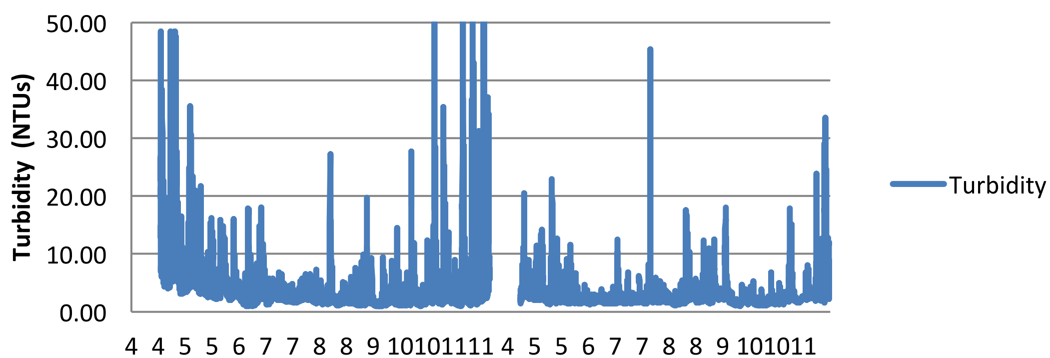
2009-2010



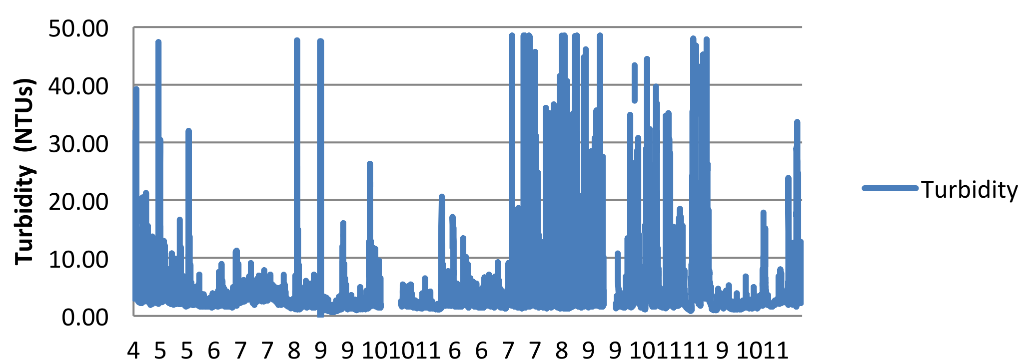
Turbidity 2005-2006



Turbidity 2007-2008



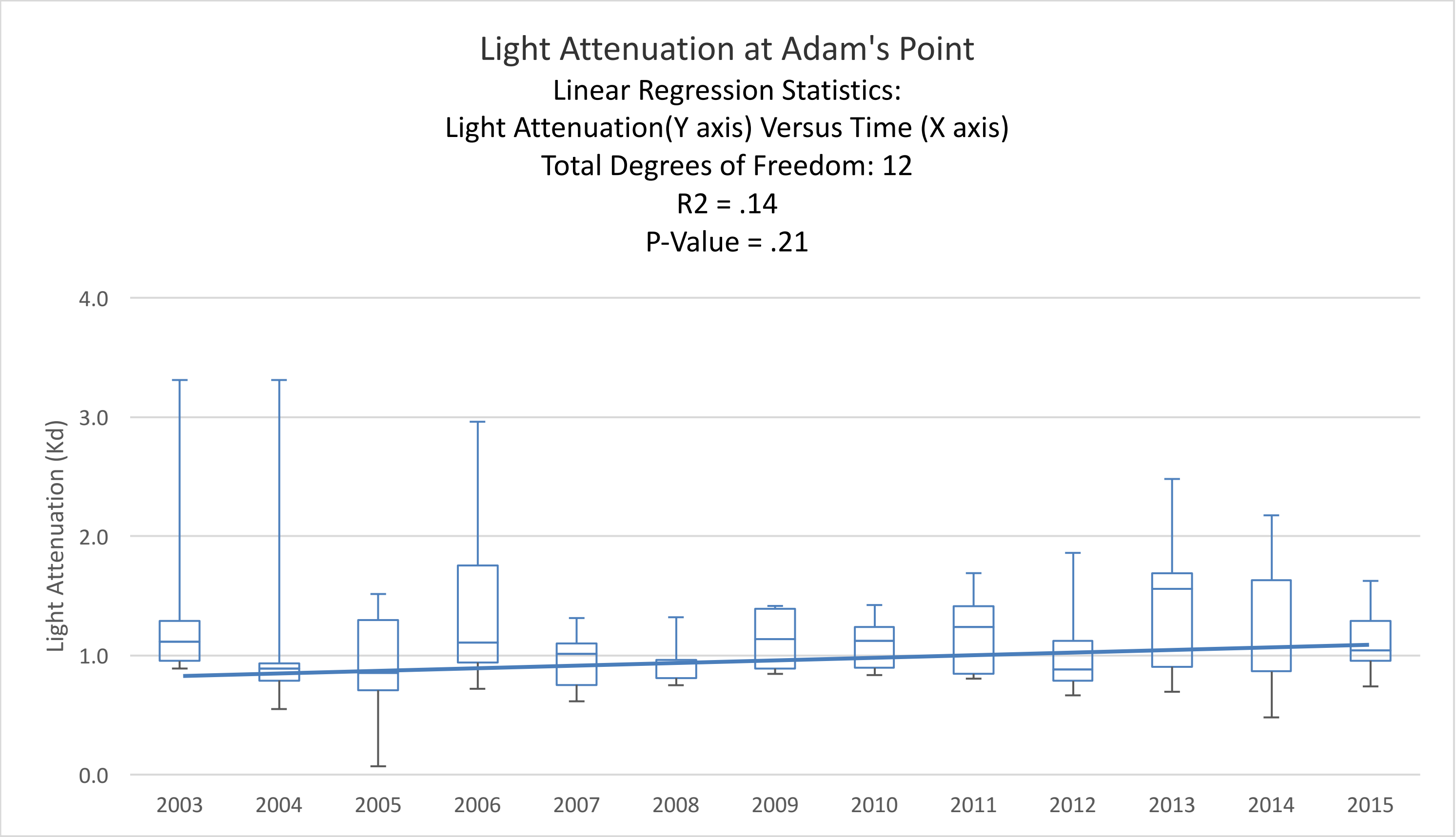
Turbidity 2009-2010



Light Attenuation Adams Point

Turbid

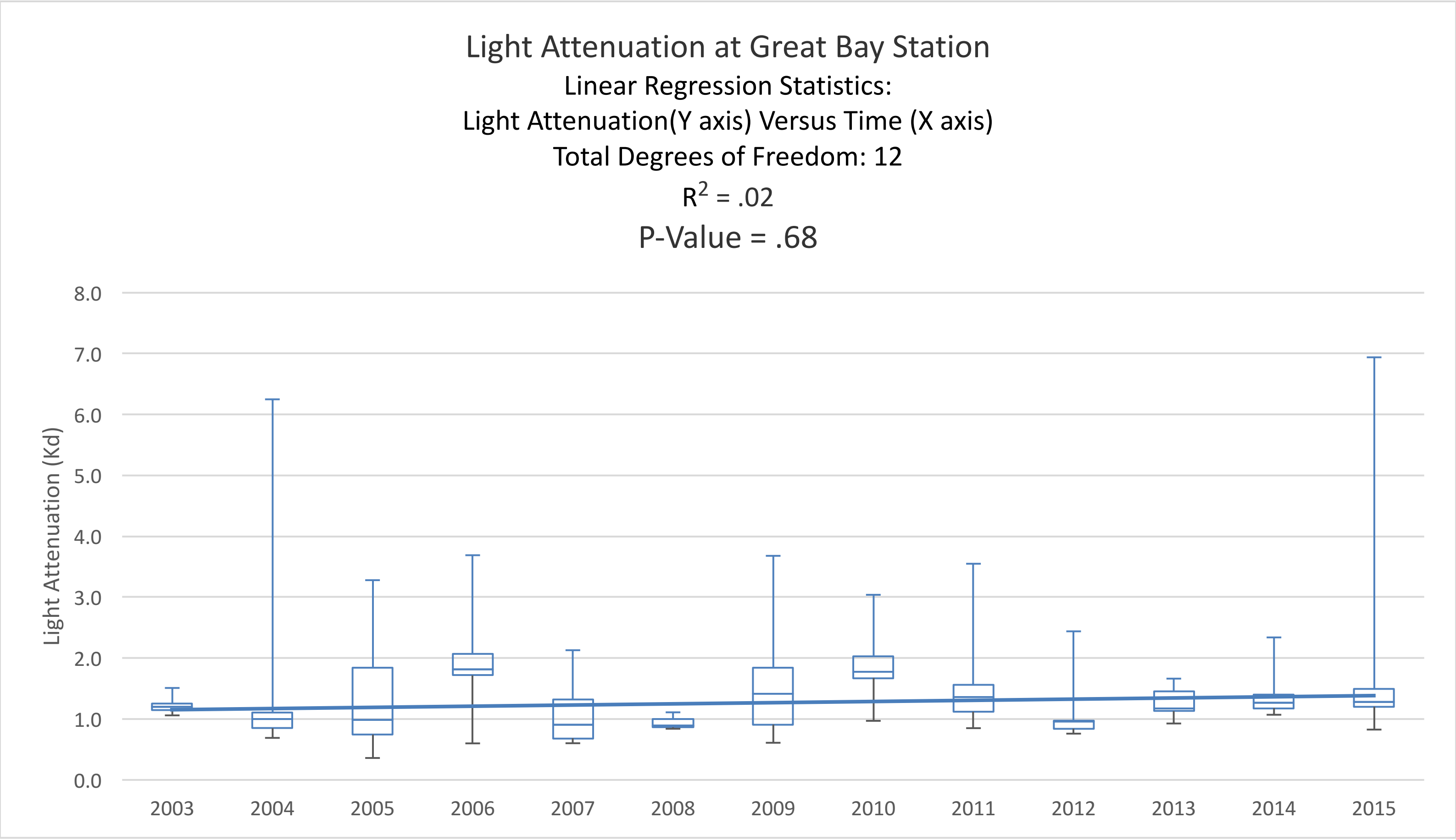
Clear



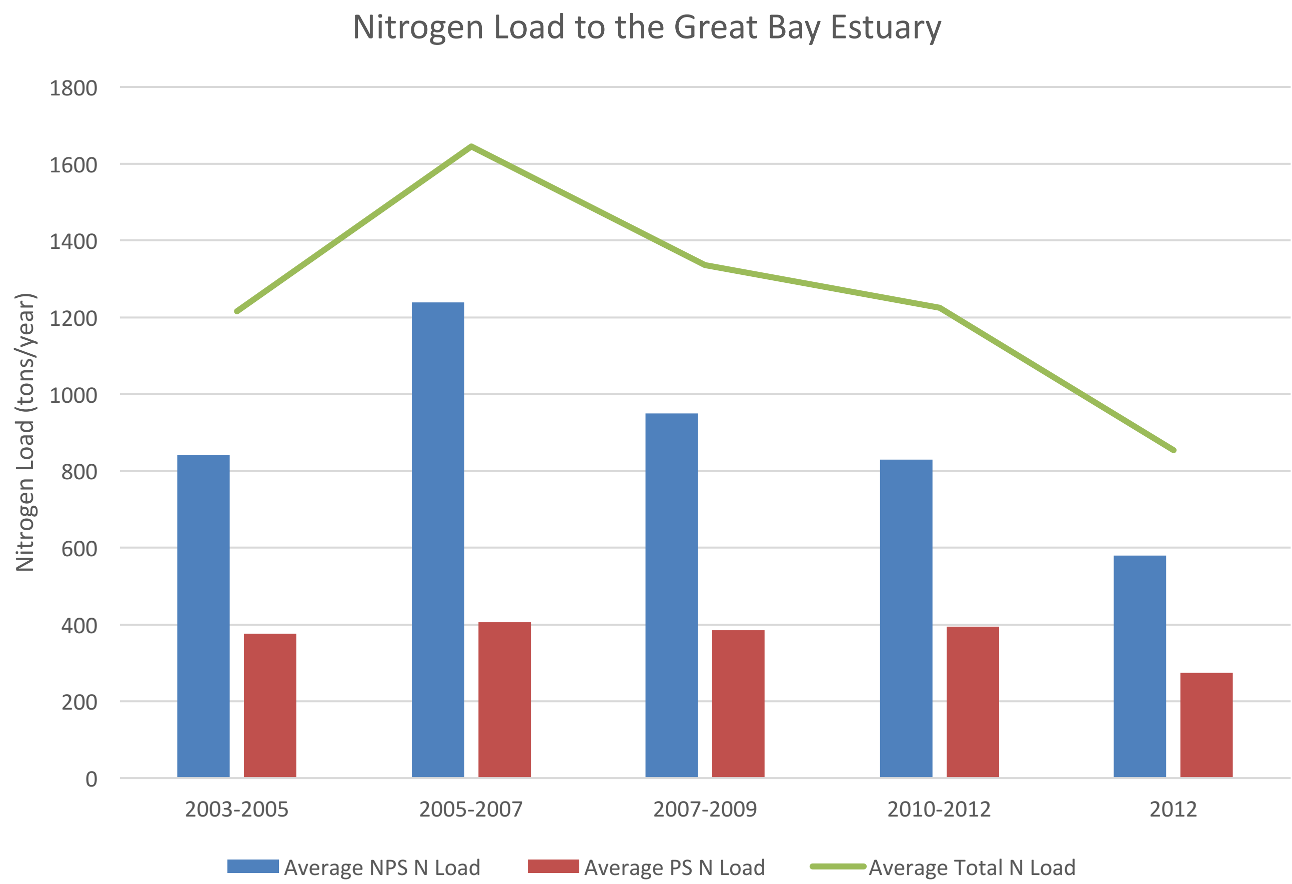
Light Attenuation Great Bay

Turbid

Clear



Nutrient Loading



Means for 3-year periods from 2003 to 2011 are estimated from 2013 State of Our Estuaries figure. The average for 2012-2016 is a preliminary estimate; not all wastewater plants have reported their data yet. Also, note that Rochester made significant WWTF upgrades in 2013 and Dover implemented upgrades in 2015. Therefore, using a period average masks the reductions in recent years. Final (and annual) numbers should be out by end of May.

Goals for this Presentation

- Discuss different eelgrass stressors (focus on Great Bay) with reference to the matrix tool
- How the stressors relate to each other especially in view of forecasted conditions

Why this Discussion? Why this Exercise?

- Eelgrass and nitrogen loading has been a divisive and controversial issue in our community.
- People continue to interpret the past 8 years in vastly different ways.
- Hard to approach consensus on how to write SOOE sections (N loading, eelgrass, phytoplankton, seaweed, etc.) without dealing with this debate.
- Also important for the new cross-cutting section earlier discussed that will be in the SOOE this year.
- Anticipating Cory Riley…Is it clear what we're doing this for and how you can help?

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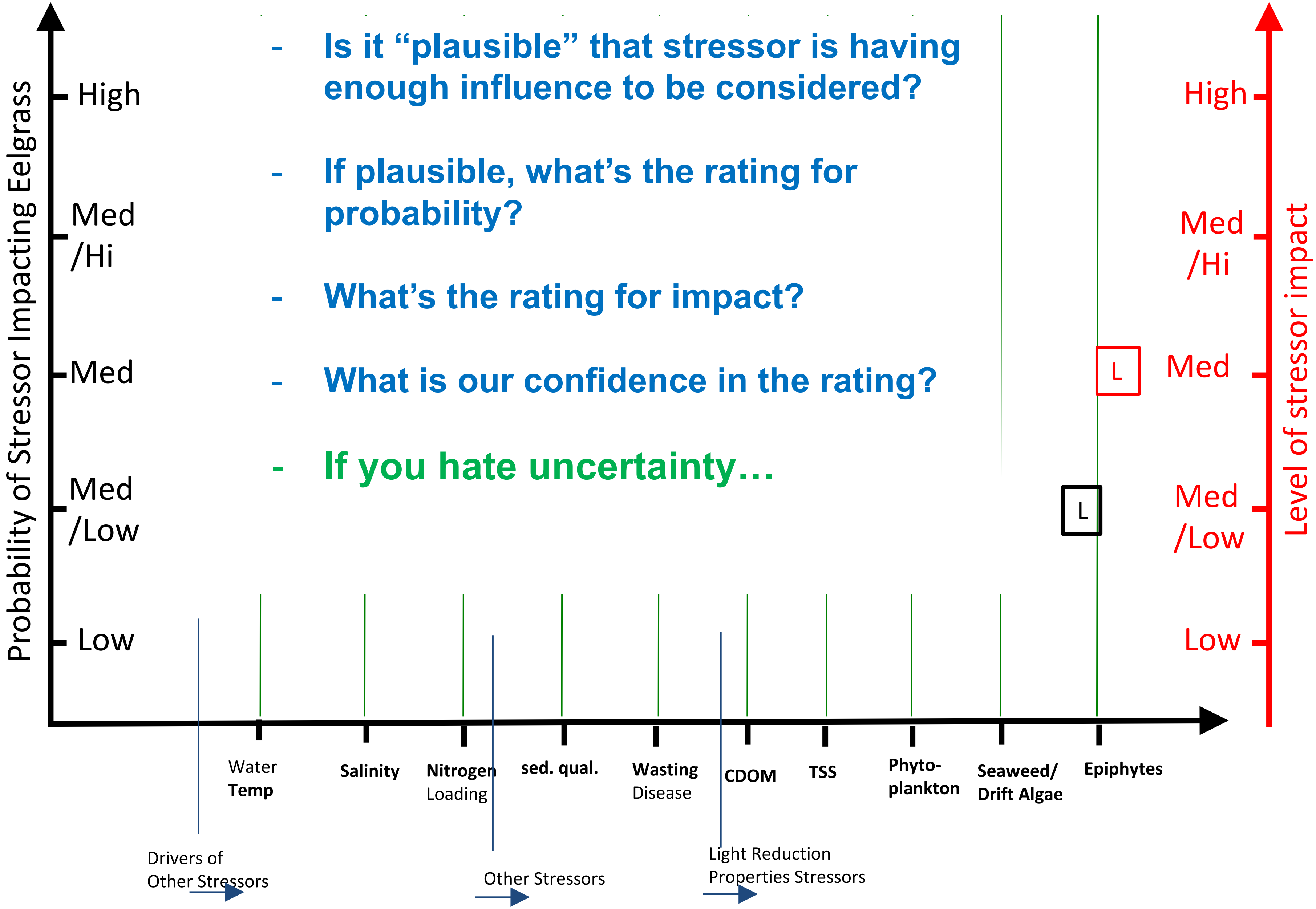
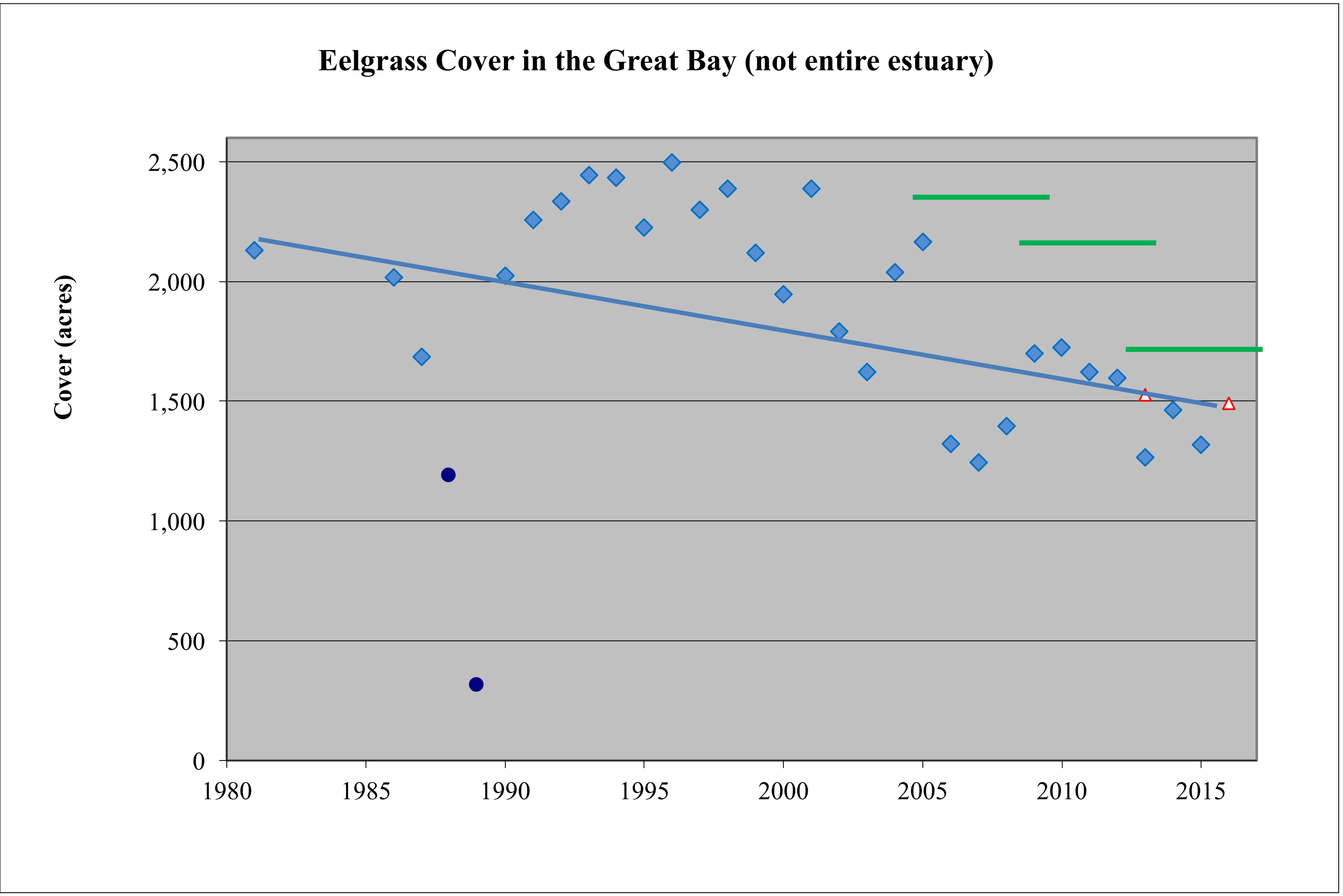
MATRIX TOOL

- Is it "plausible" that stressor is having enough influence to be considered?
- If plausible, what's the rating for probability?
- What's the rating for impact?
- What is our confidence in the rating?
- If you hate uncertainty…



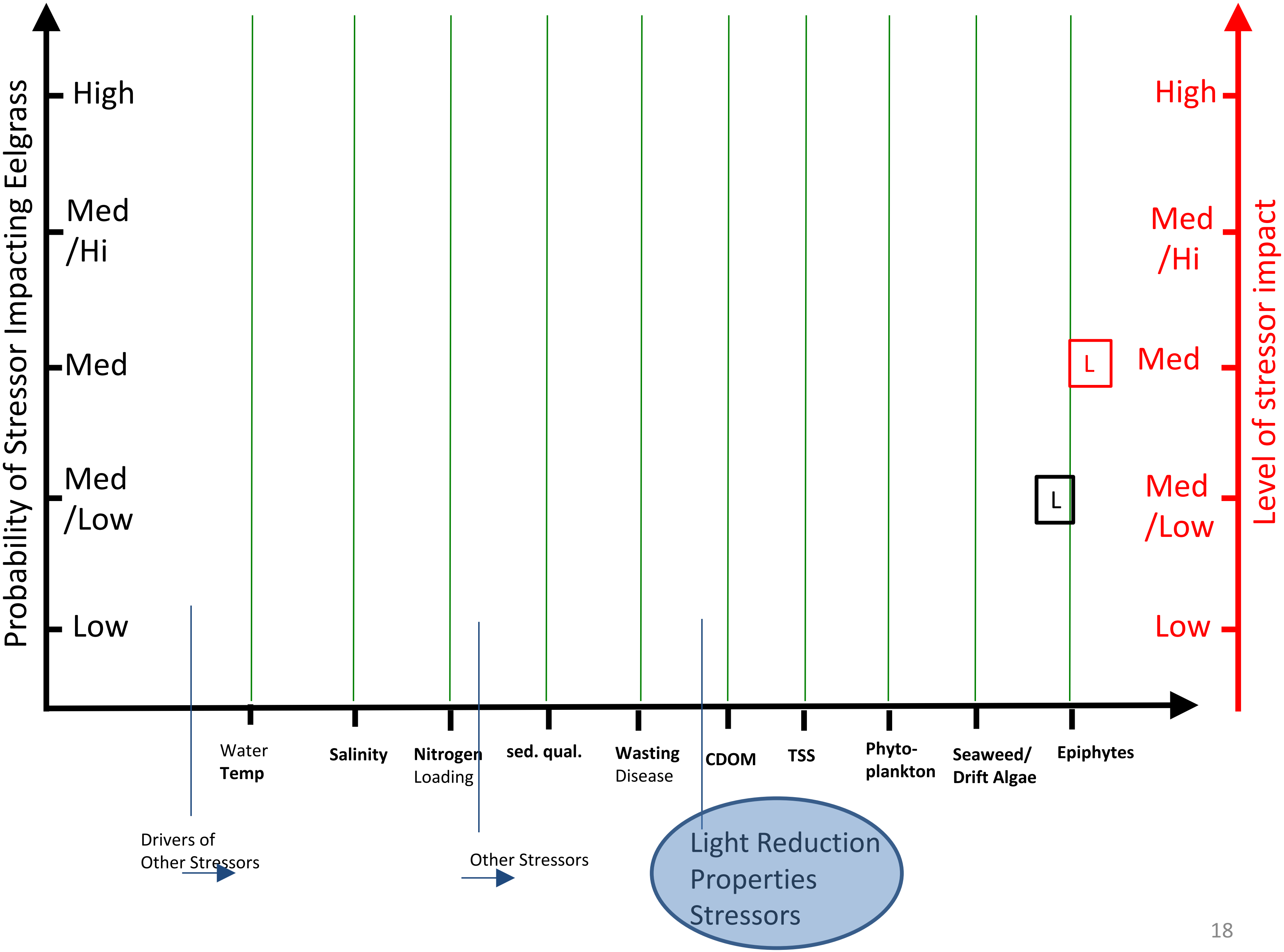
Great Bay Eelgrass



Trendline includes years during “Wasting Disease” event.
R Square = .11
P-value = .07

- Eelgrass has good years and bad years
- But why does it seem to be losing its ability to recover (the green lines)

MATRIX TOOL



Probability of Stressor Impacting Eelgrass
High
Med /Hi
Med
Med /Low
Low
Level of stressor impact
High
Med /Hi
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Med /Low
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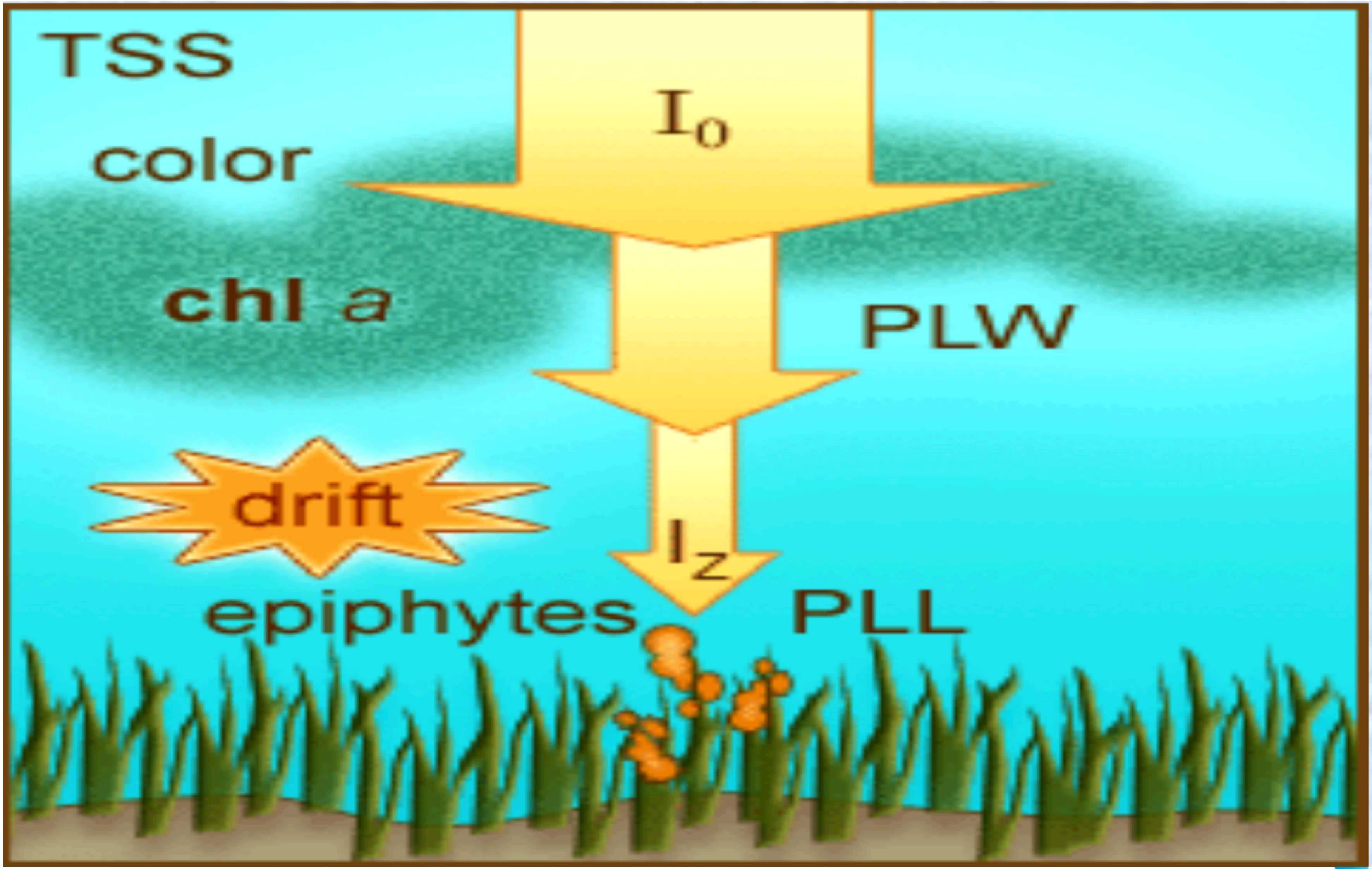
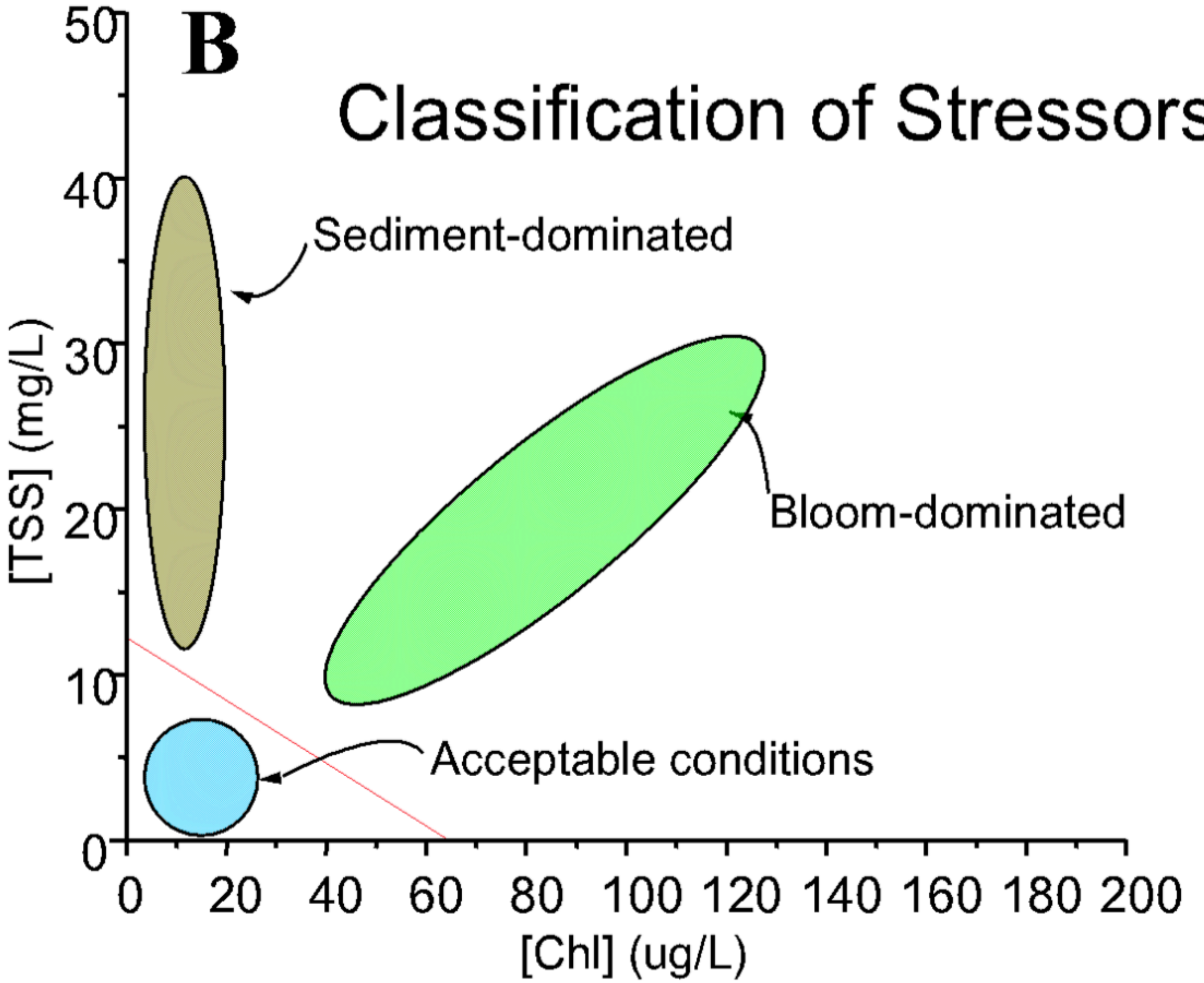
Water Temp
Salinity
Nitrogen Loading
sed. qual.
Wasting Disease
CDOM
TSS
Phyto-plankton
Seaweed/ Drift Algae
Epiphytes
Drivers of Other Stressors
Other Stressors
Light Reduction Properties Stressors

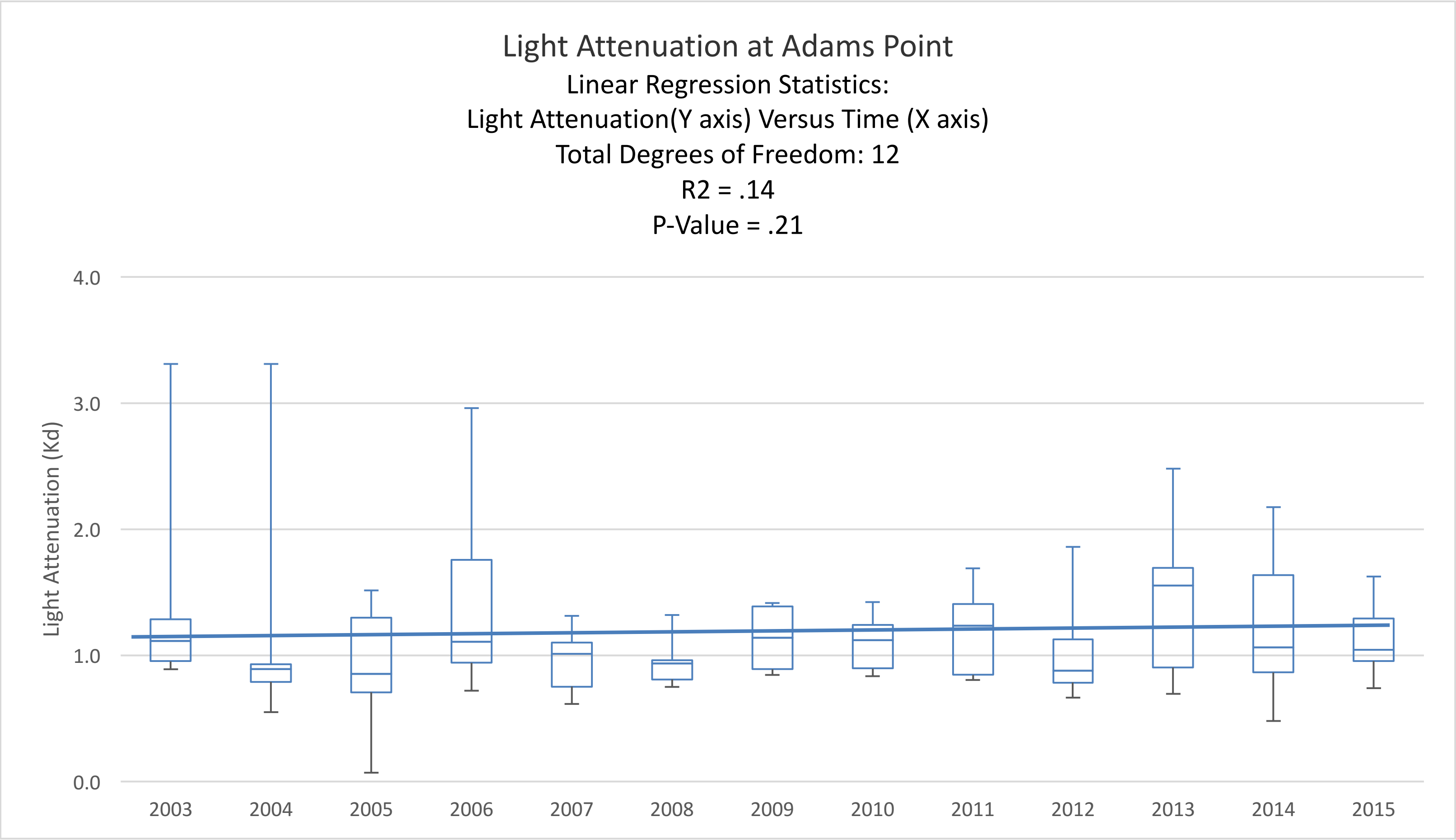
Reducing Light to Eelgrass Leaves



Reducing Light to Eelgrass Leaves



Is Less Light Getting to Eelgrass Leaves?



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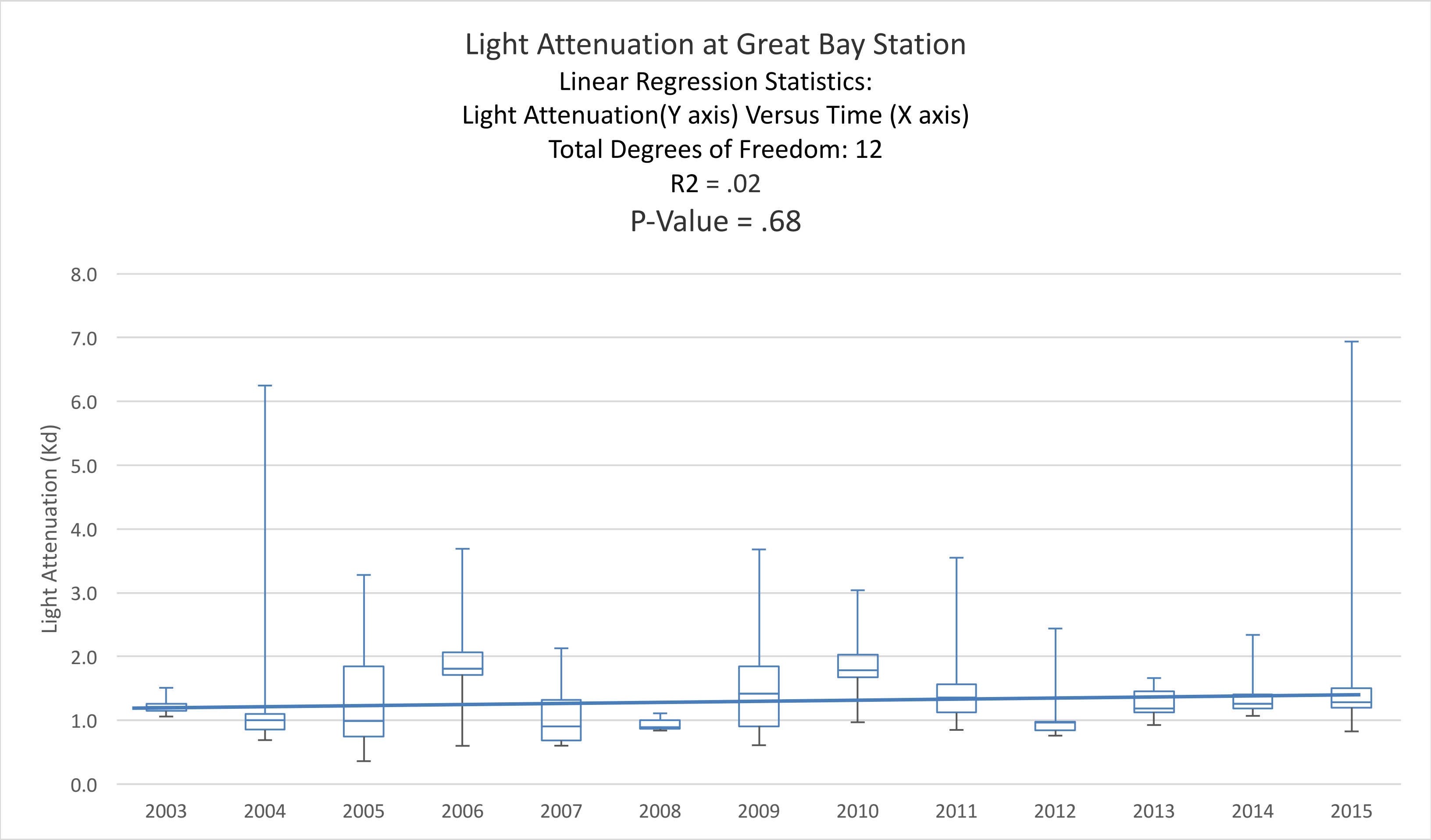
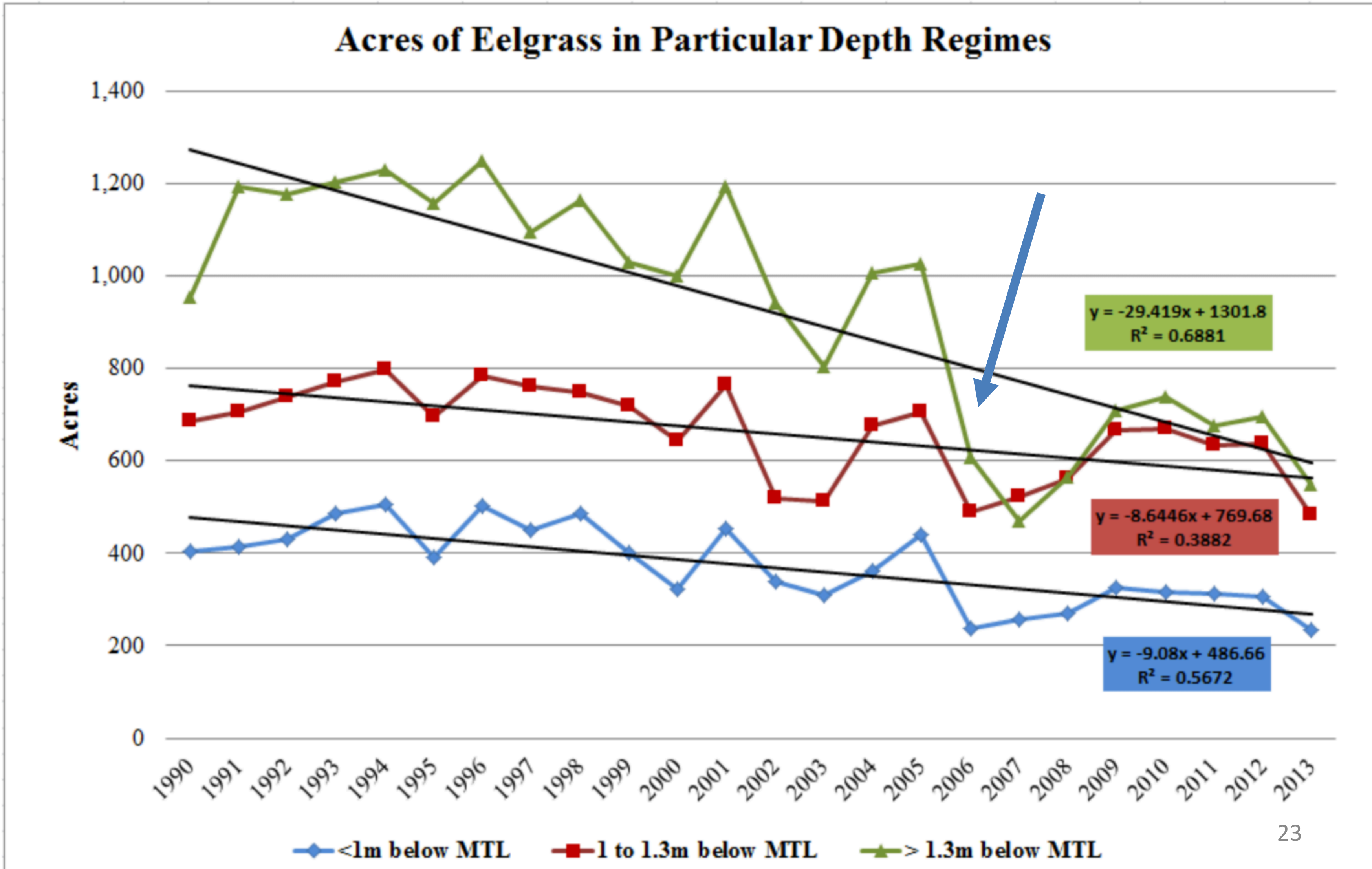
Is Less Light Getting to Eelgrass Leaves?



Is Less Light Getting to Eelgrass Leaves?

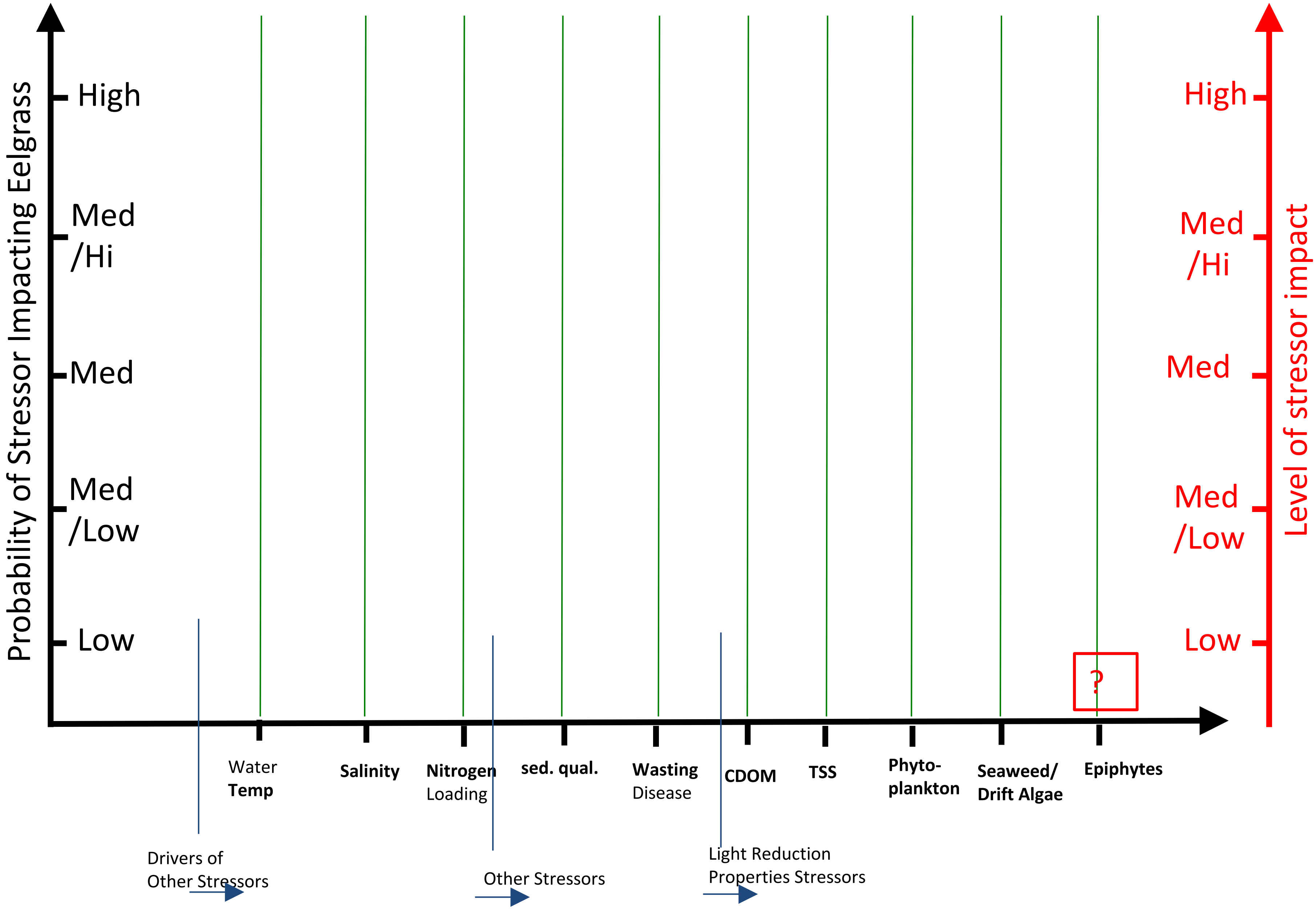
Figure 2: Acres of eelgrass in Great Bay over time in depth regimes relative to 2009 based bathymetry.



Is Less Light Getting to Eelgrass Leaves?

Evidence suggests this is may be happening

MATRIX TOOL


Probability of Stressor Impacting Eelgrass
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Water Temp
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Nitrogen Loading
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Wasting Disease
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Seaweed/ Drift Algae
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Other Stressors
Light Reduction Properties Stressors

Seaweed (in particular drift seaweed)

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Intertidal Seaweed (in particular drift seaweed)

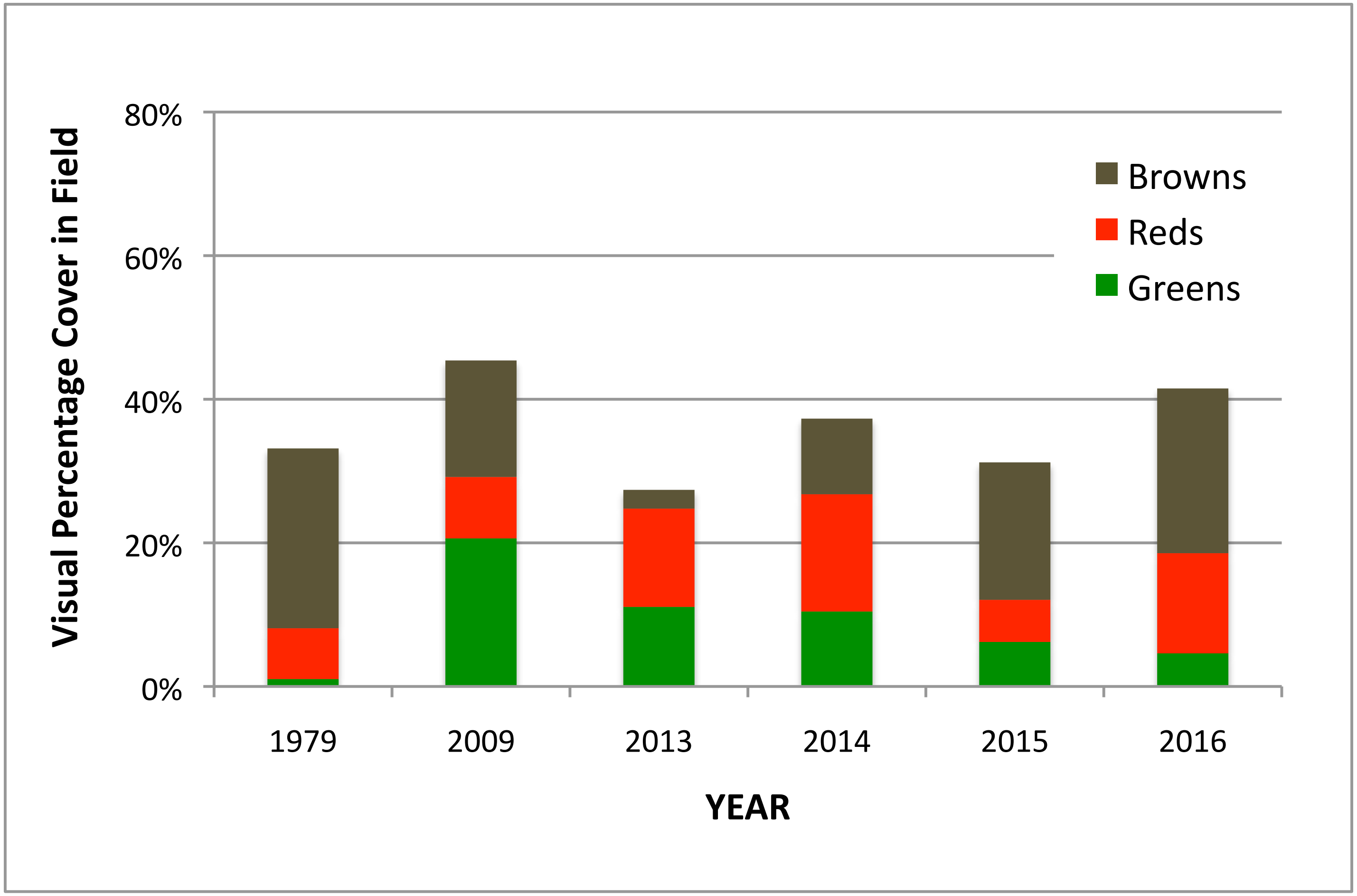

Figure 1. Intertidal percent cover of brown, red and green seaweeds for 2009-2016. Data were limited to collections at five sites within the Estuary in August and September from 0.0 m to 1.5 m above mean low tide (MLW). 2014 had data from only four sites. In 1979 data were collected in summer, fall and the following spring from 3 sites.

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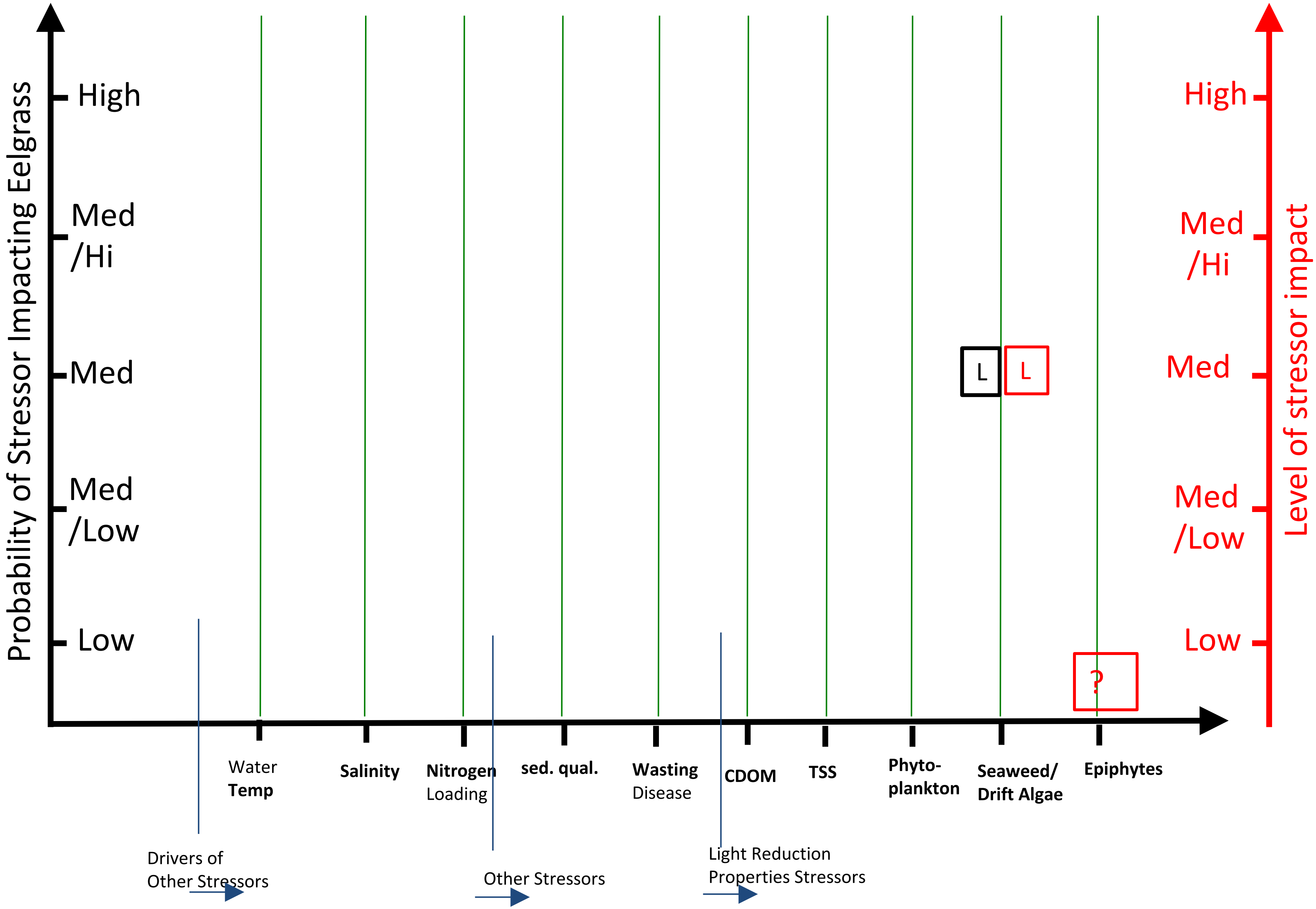
MATRIX TOOL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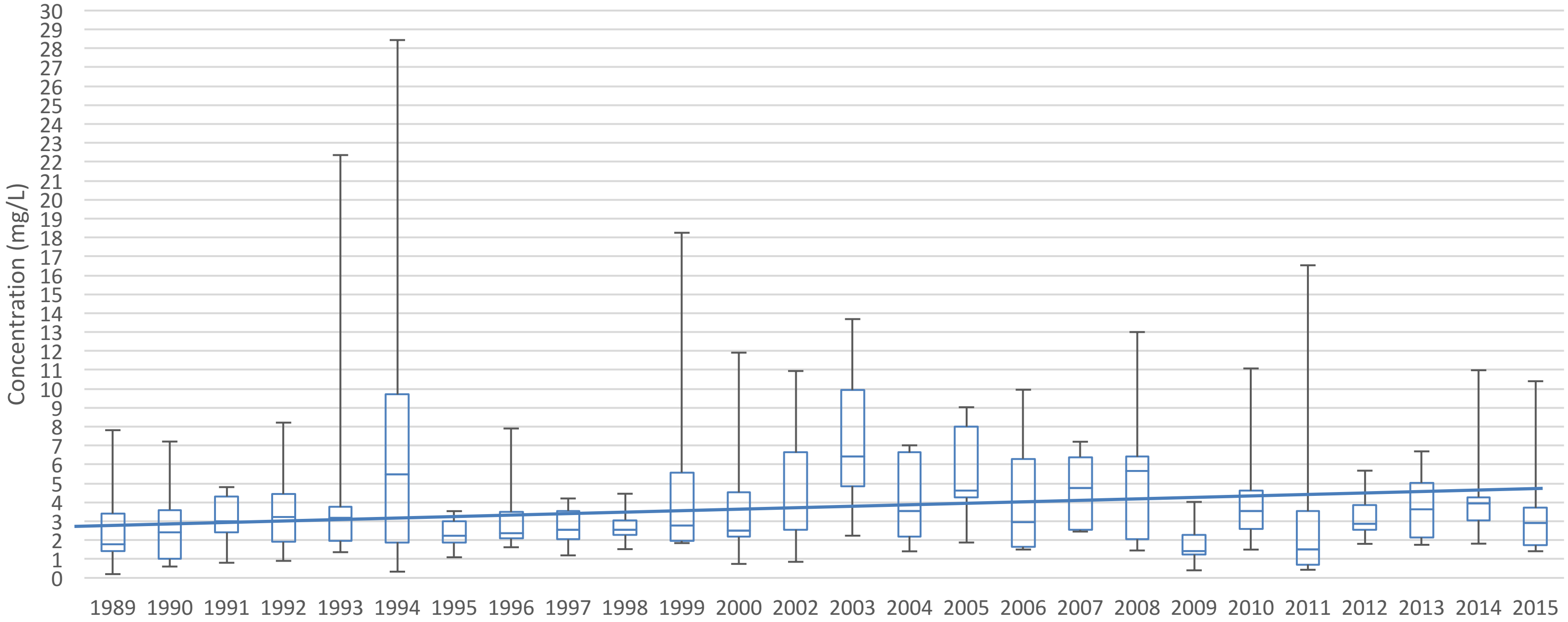
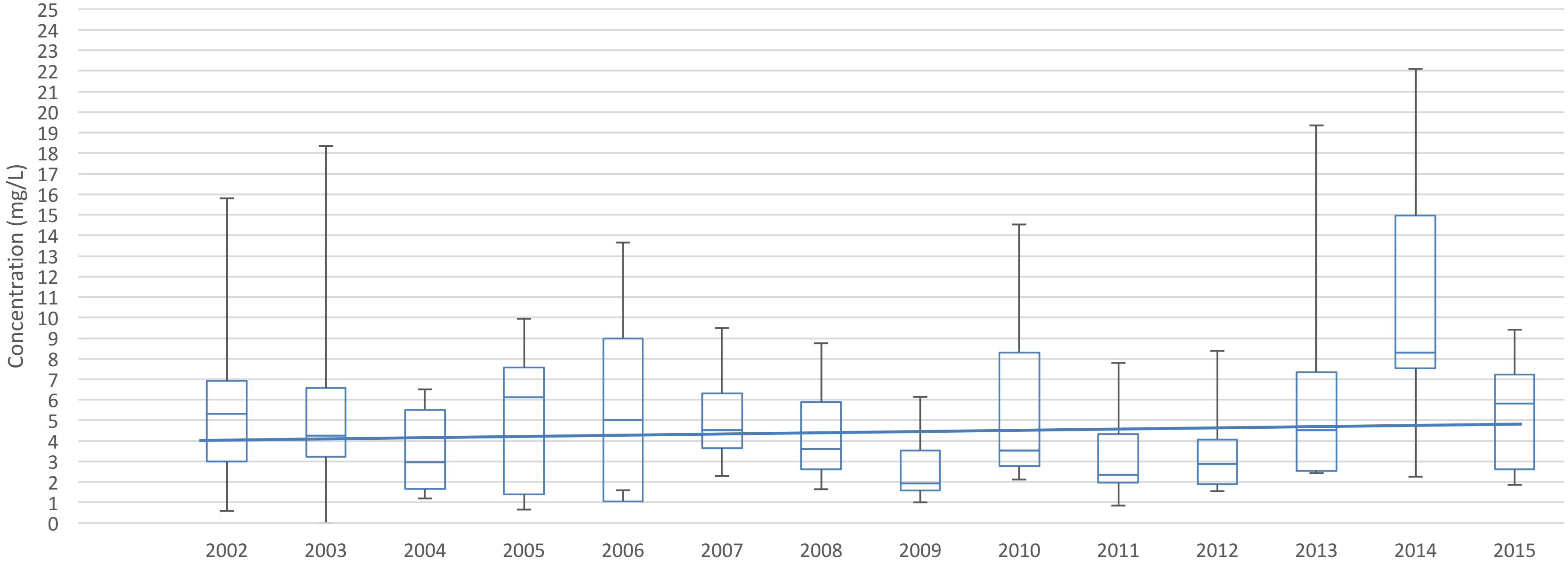
Phytoplankton

Chlorophyl A Concentrations at Adam's Point
Linear Regression Statistics:
Median Concentration (Y axis) Versus Time (X axis)
Total Degrees of Freedom: 25
R^2 = .03
P-Value = .4
No Statistical Trend



Phytoplankton

Chlorophyl A Concentrations at Great Bay
Linear Regression Statistics:
Median Concentration (Y axis) Versus Time (X axis)
Total Degrees of Freedom: 13
$R^2 = .02$
P-Value = .66
No Statistical Trend



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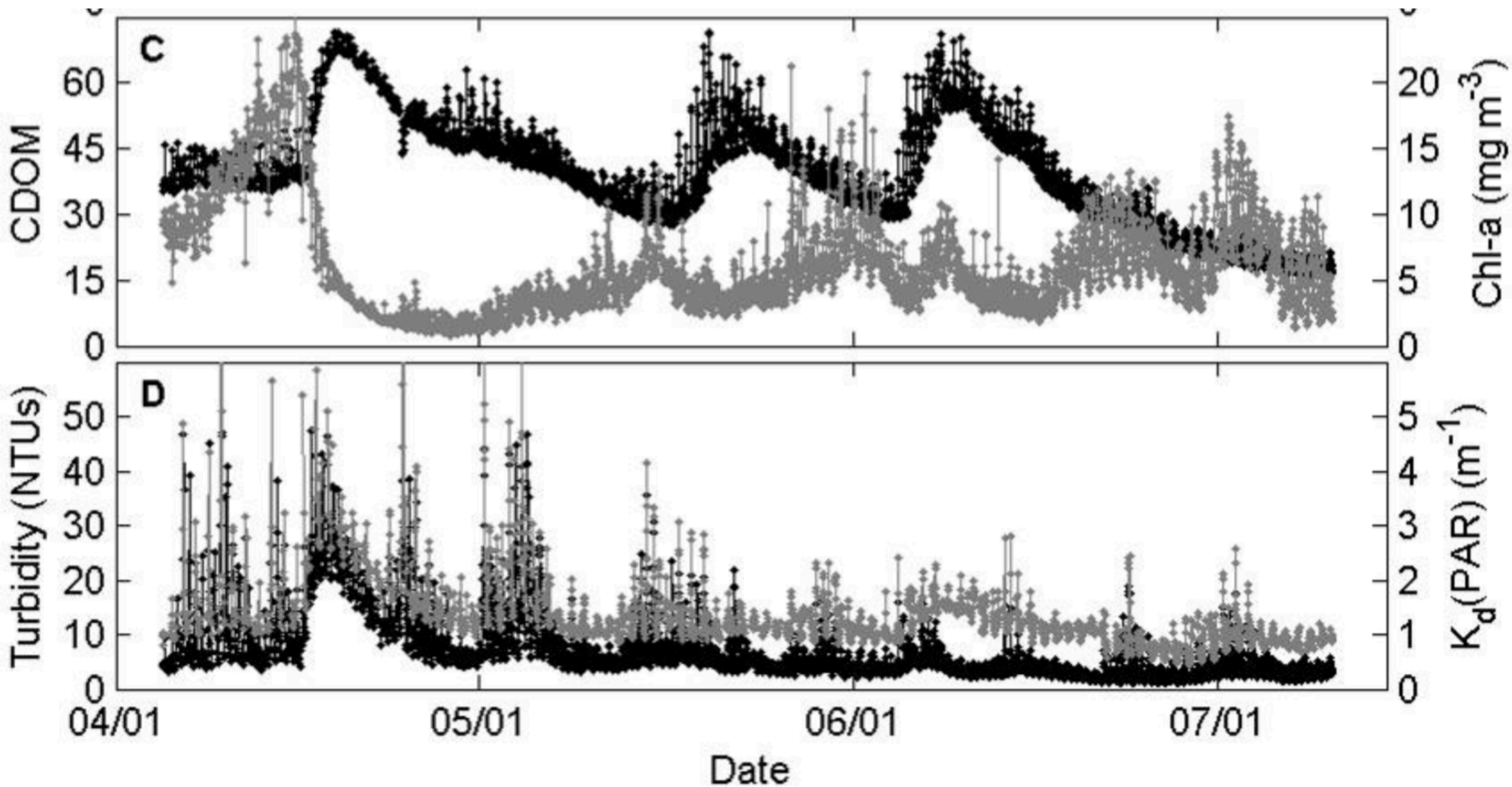
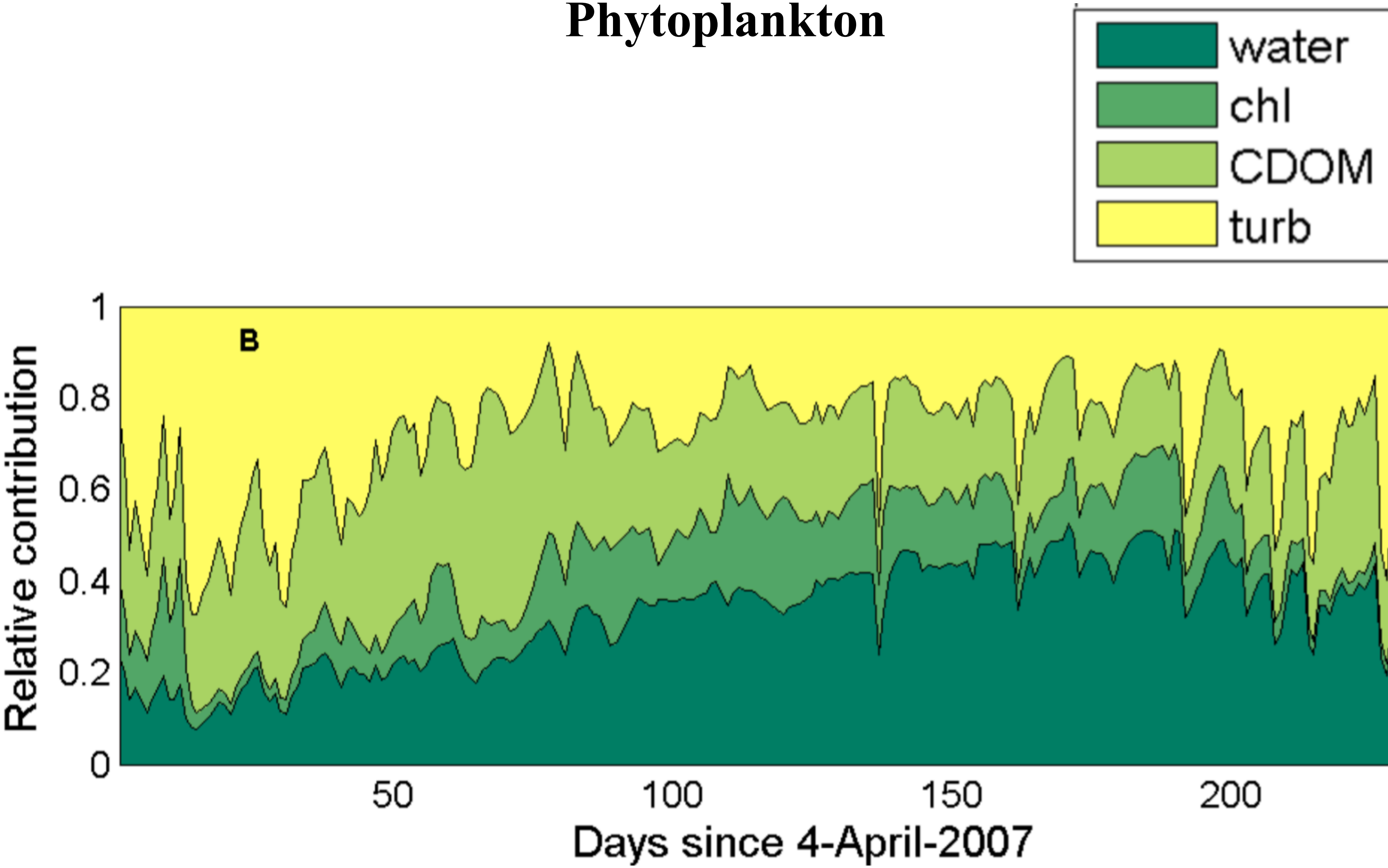
Phytoplankton



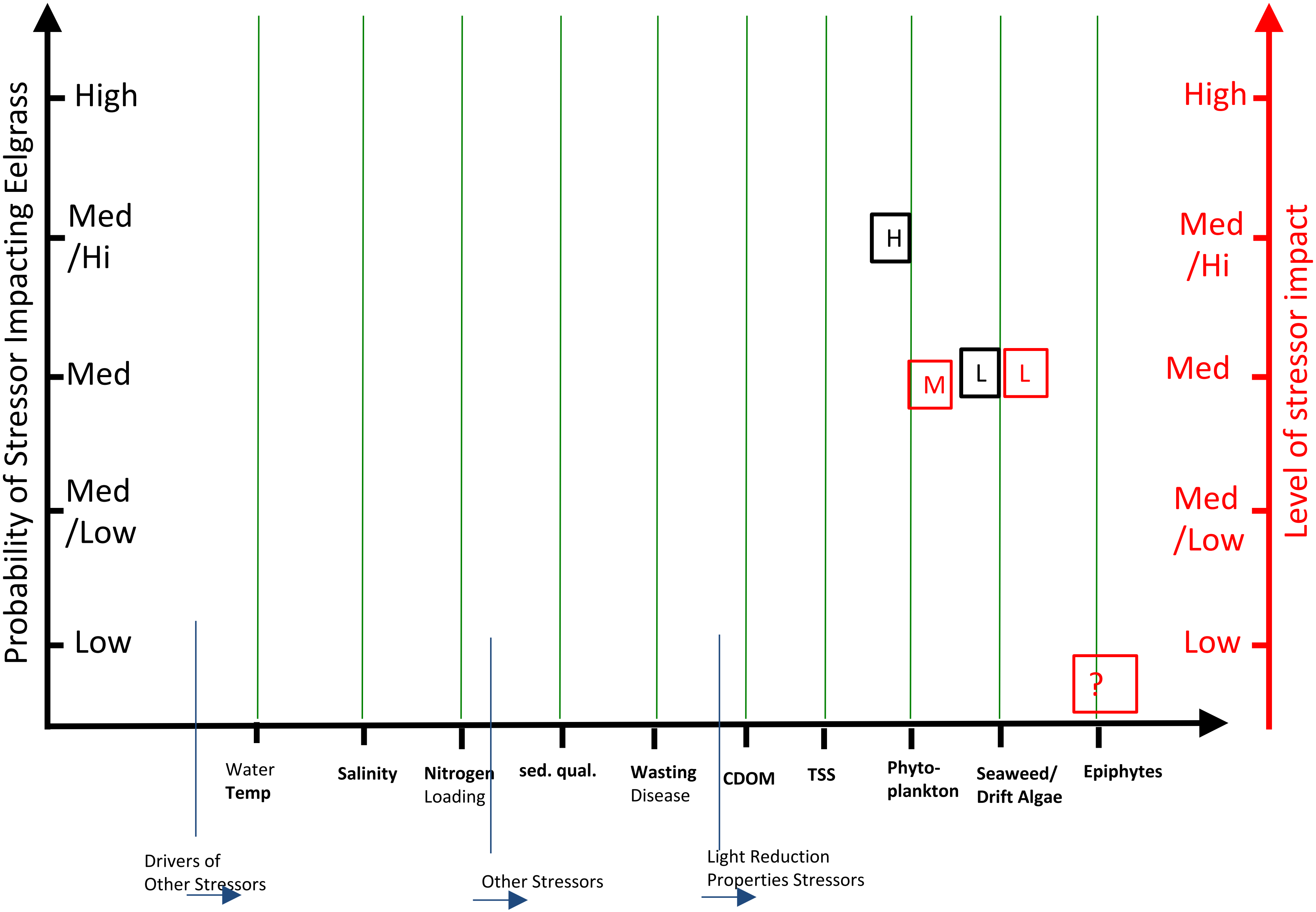
Morrison et al, 2008

Phytoplankton



Morrison et al, 2008

MATRIX TOOL


Probability of Stressor Impacting Eelgrass
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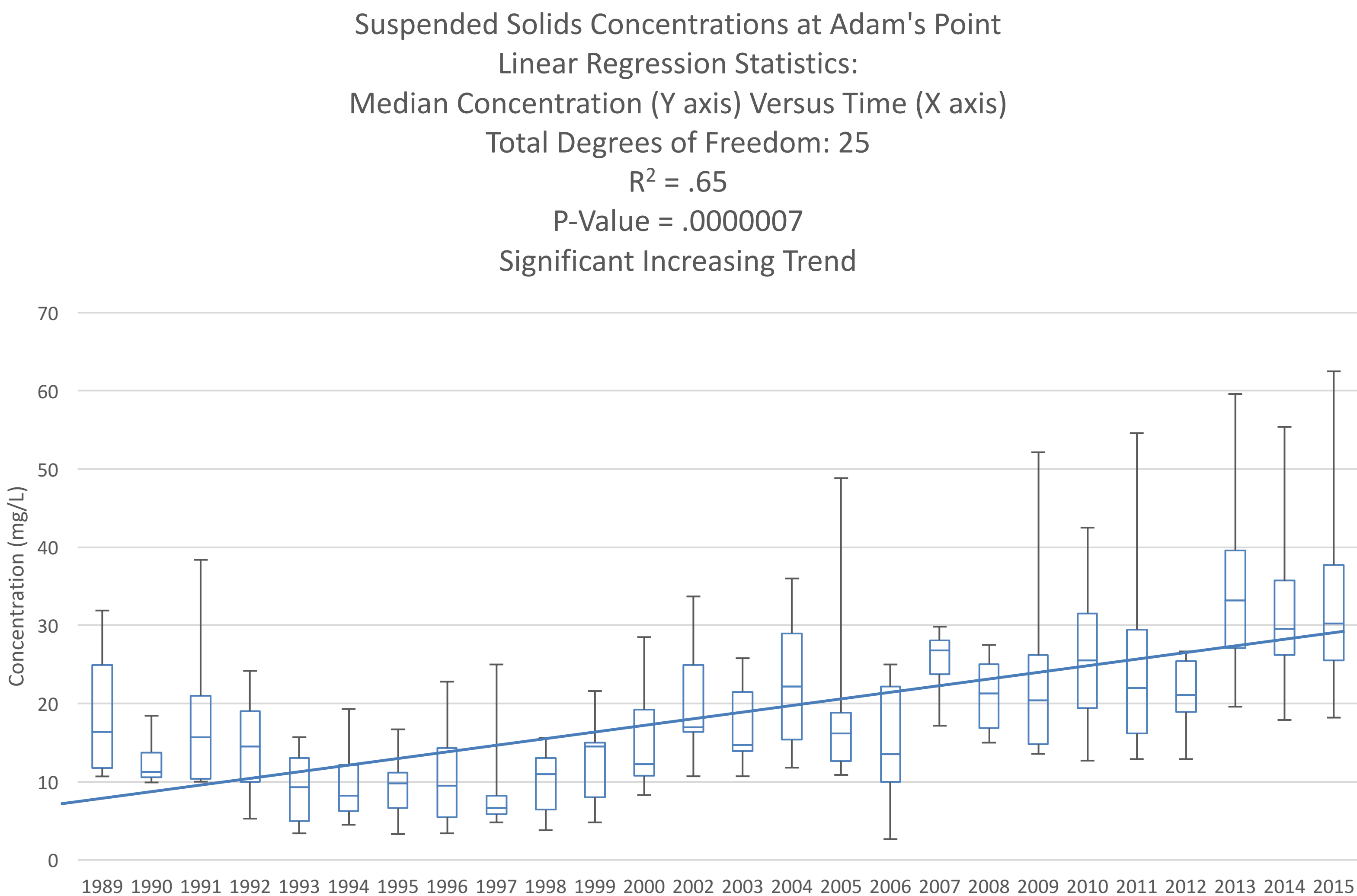
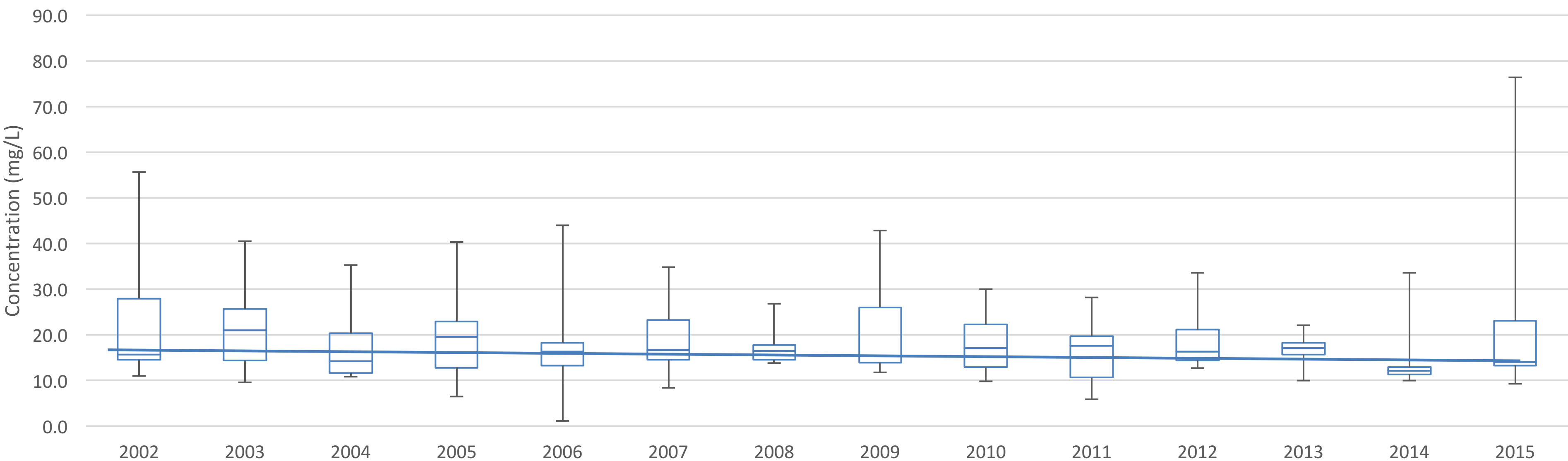
Other Stressors
Light Reduction Properties Stressors

TSS (Total Suspended Solids)



TSS (Total Suspended Solids)

Suspended Sediment Concentrations at the Great Bay Station
Linear Regression Statistics:
Median Concentration (Y axis) Versus Time (X axis)
Total Degrees of Freedom: 25
$R^2 = .21$
P-Value = .10
No Statistical Trend



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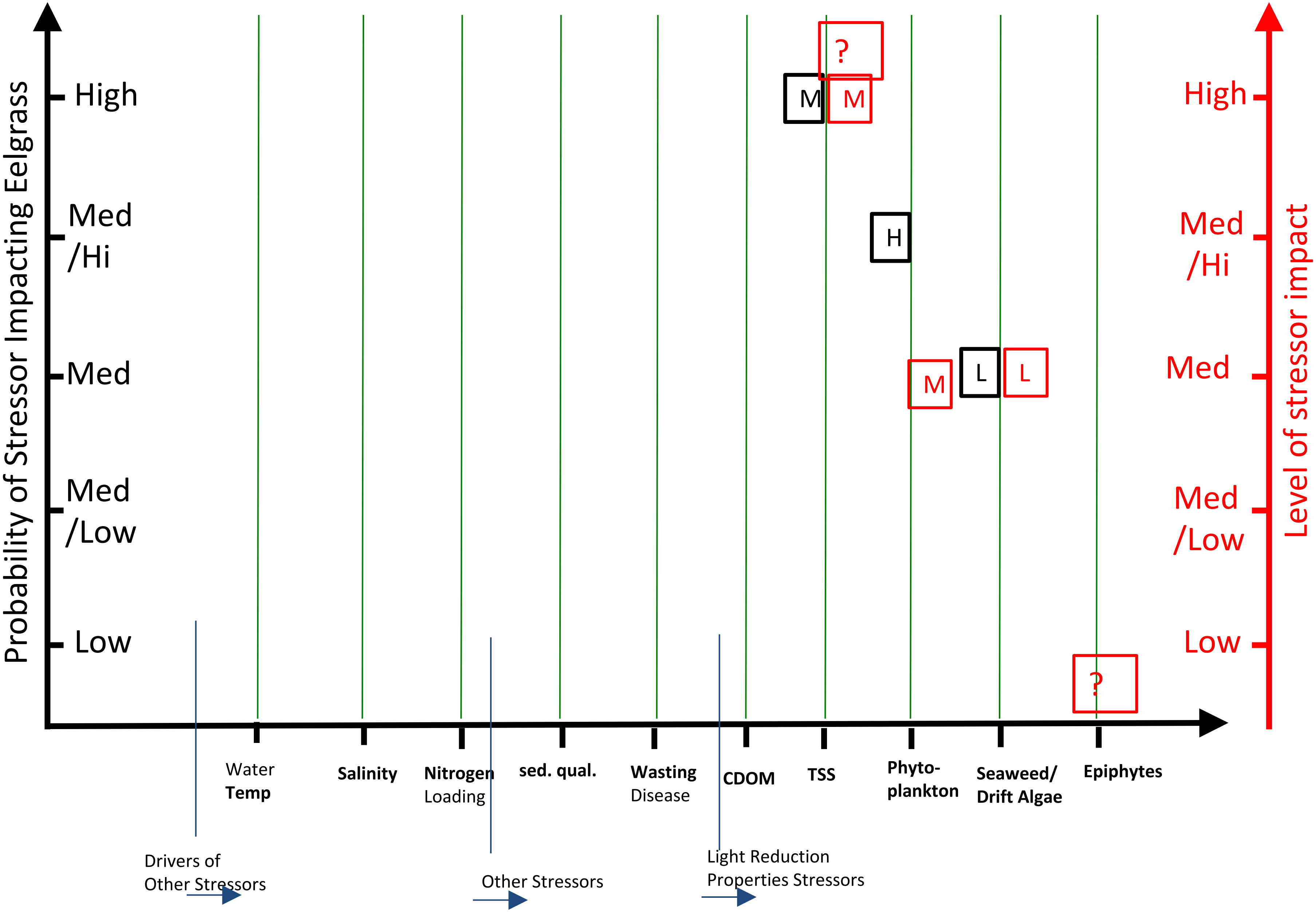
Probability of Stressor Impacting Eelgrass
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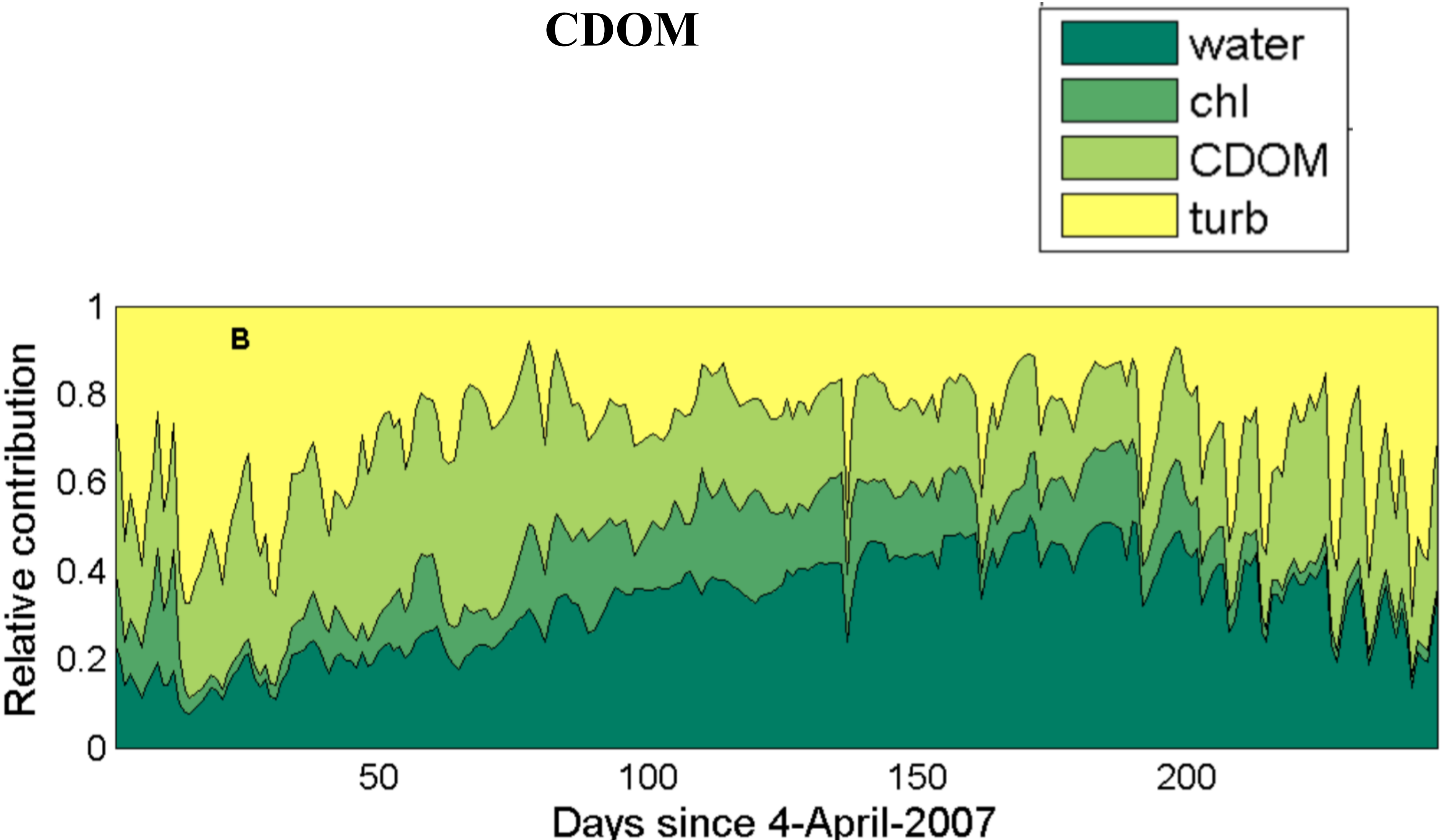
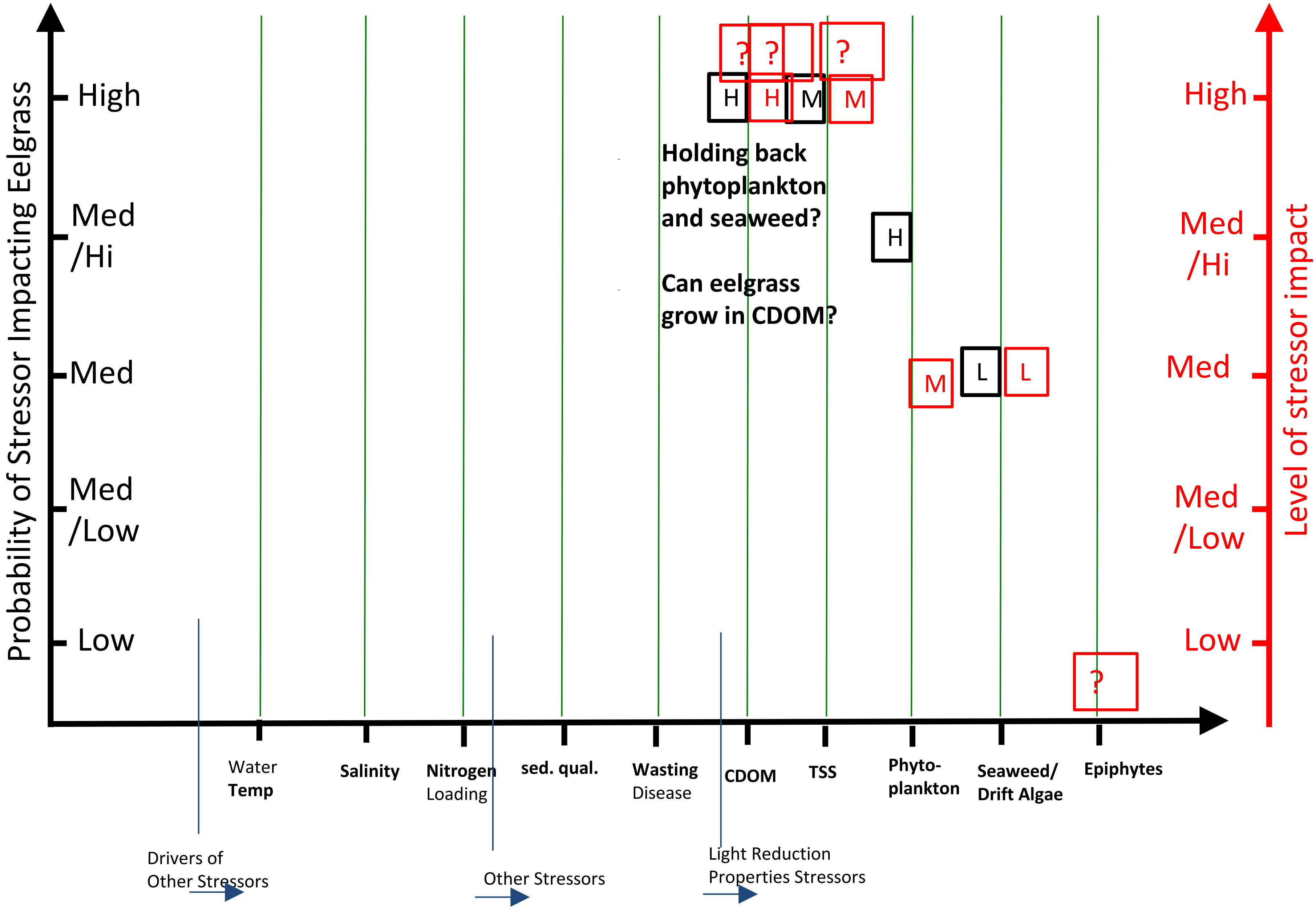
CDOM



Morrison et al, 2008

MATRIX TOOL



Probability of Stressor Impacting Eelgrass
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Holding back phytoplankton and seaweed?
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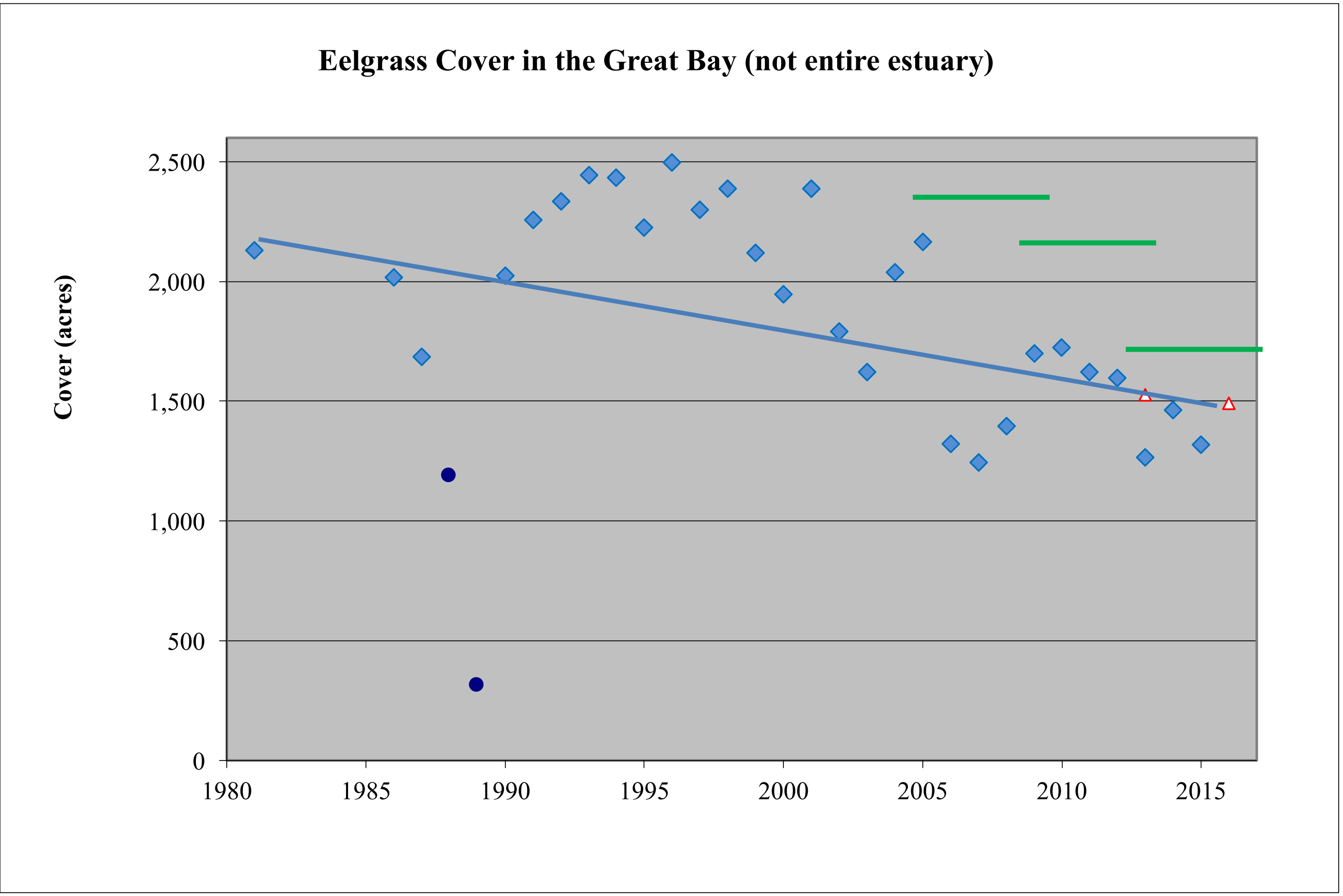
sed. qual.
Wasting Disease
CDOM
TSS
Phyto-plankton
Seaweed/ Drift Algae
Epiphytes
Drivers of Other Stressors
Other Stressors
Light Reduction Properties Stressors

Wasting Disease



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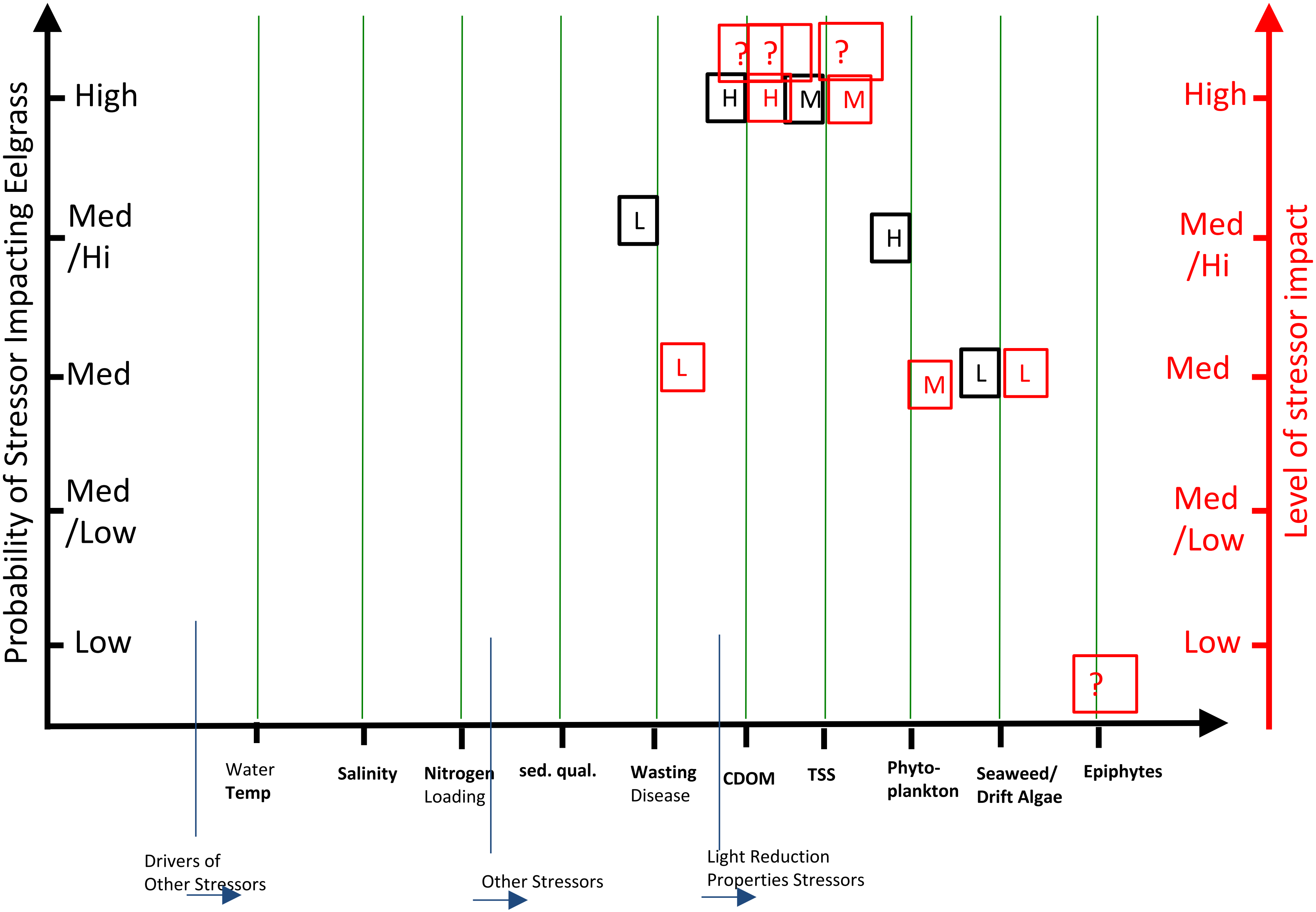

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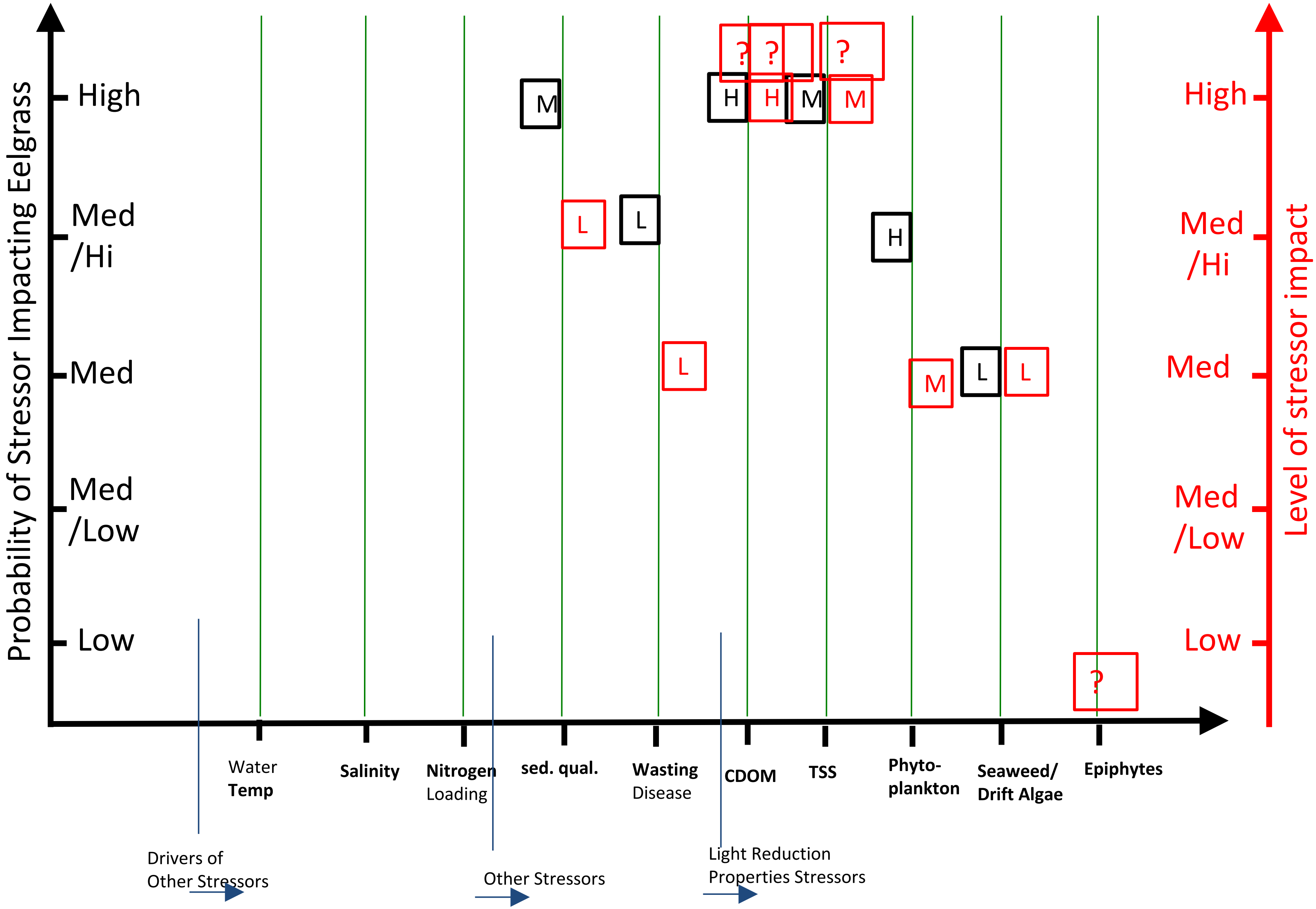
Sediment Quality

Picture by Kasper Elgetti Brodersen

MATRIX TOOL



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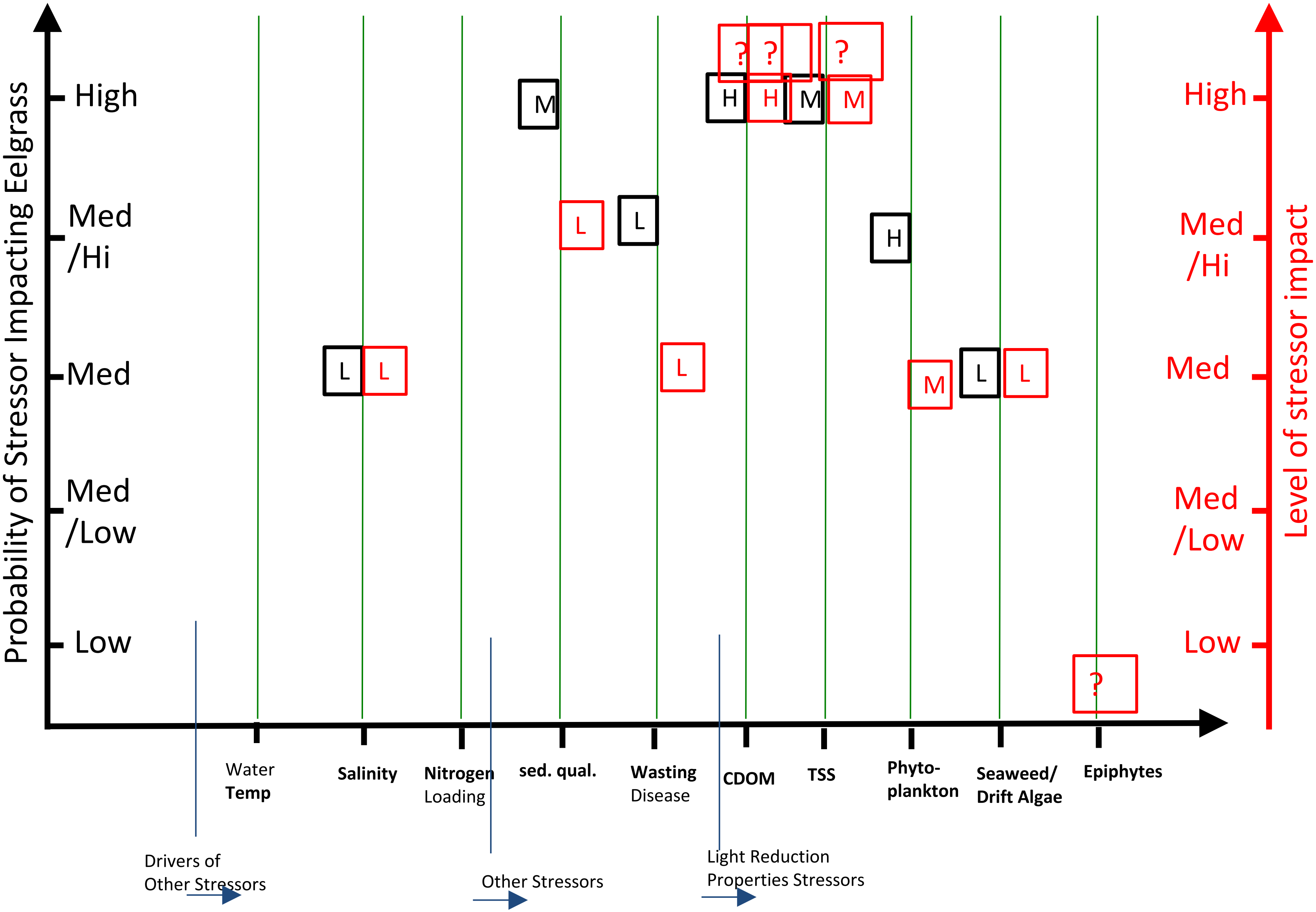
MATRIX TOOL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Epiphytes
Drivers of Other Stressors
Other Stressors
Light Reduction Properties Stressors
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Rising Water Temperatures

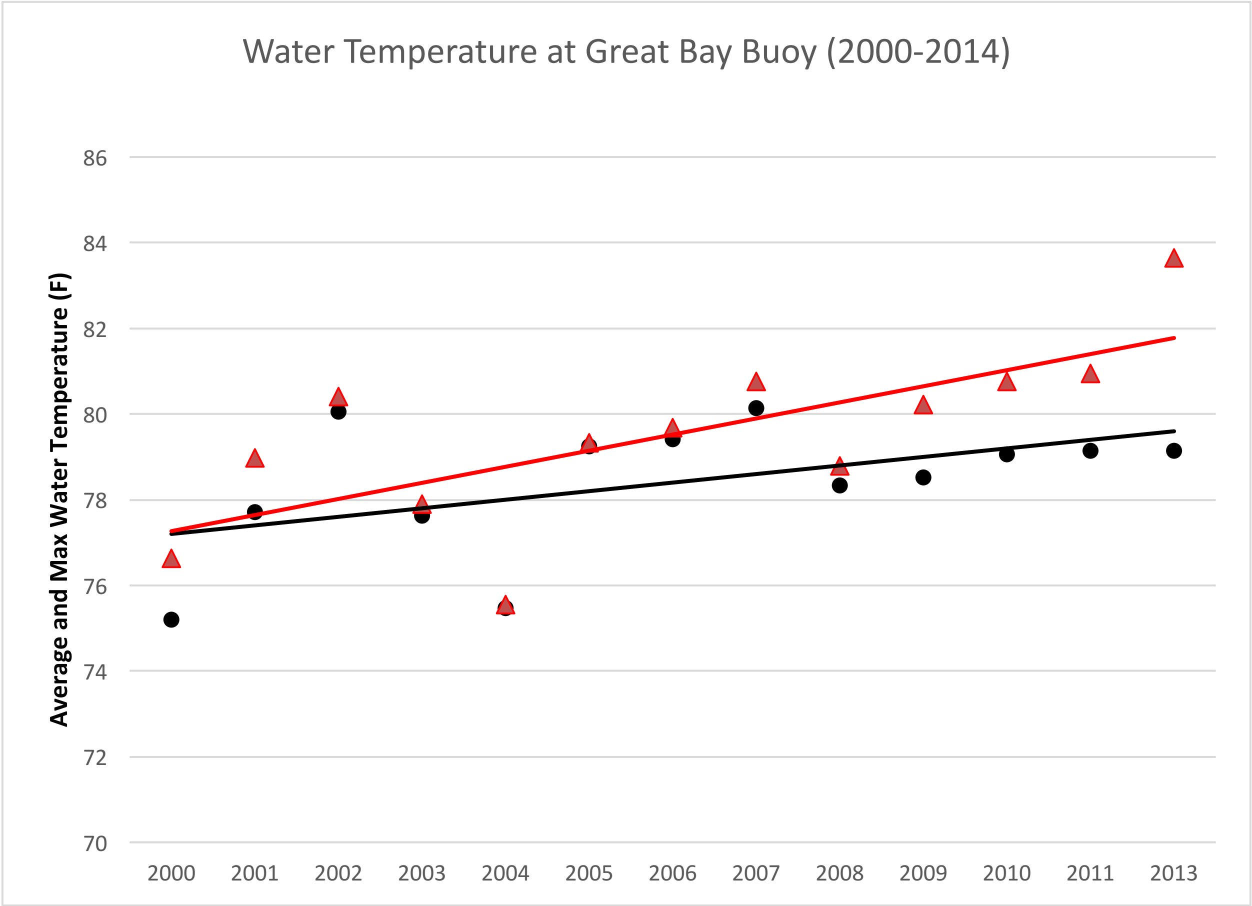

Figure 1. Average and Max water temperature from the Great Bay (NERR) Buoy. Data are from July and August, combined. Note that the years 2012 and 2014 are not included as July data was missing. In the chart above, red triangles depict max temperature for the two-month period; black circles depict average temperature for the two months. The red trendline (R^2 = .53 and P-Value = .005) is for max temperature and the black trendline is for average temperature (R^2 = .25 and P-Value = .09.)

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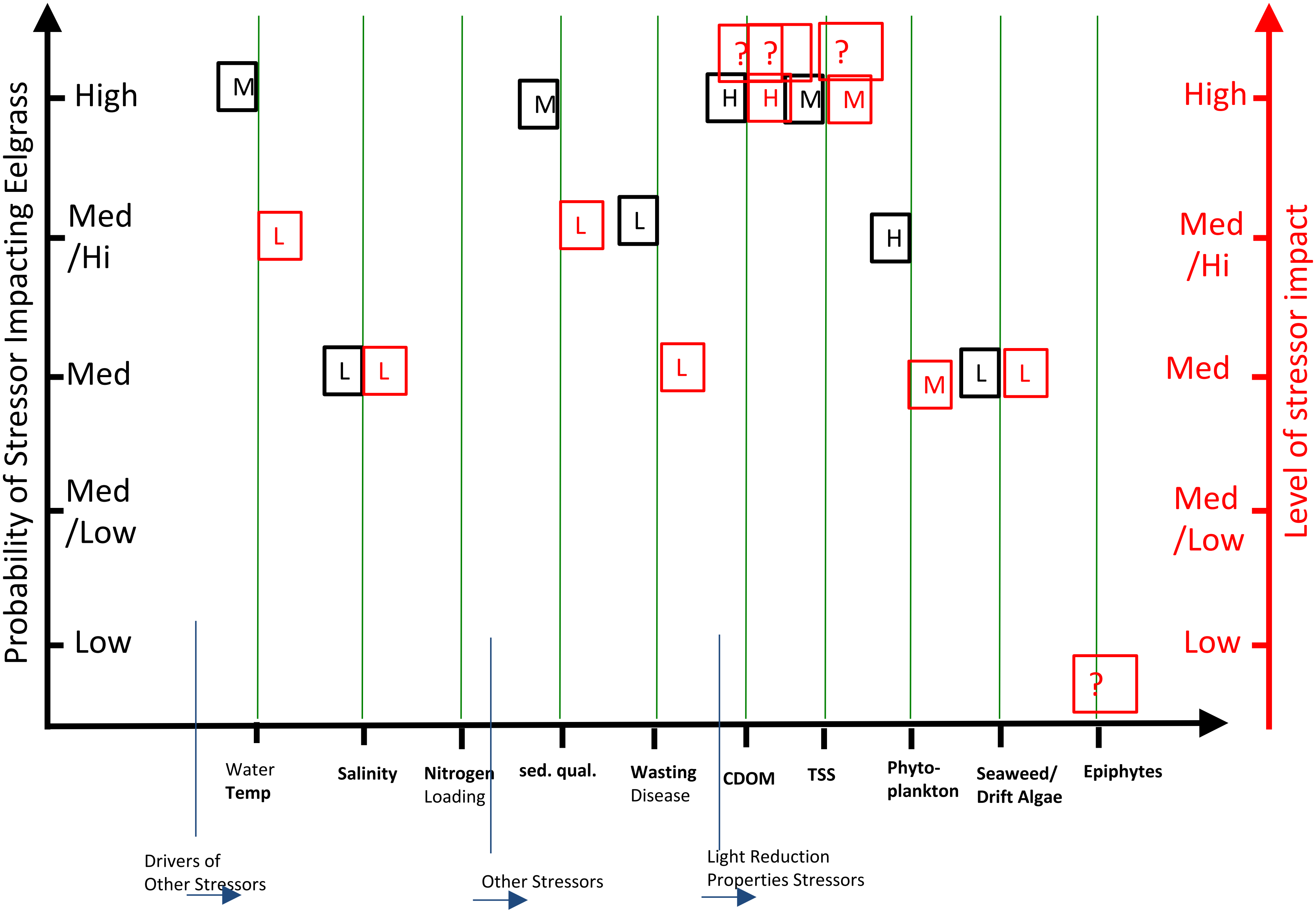

Probability of Stressor Impacting Eelgrass
High
Med /Hi
Med
Med /Low
Low
Level of stressor impact
High
Med /Hi
Med
Med /Low
Low
Water Temp
Salinity
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sed. qual.
Wasting Disease
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Drivers of Other Stressors
Other Stressors
Light Reduction Properties Stressors
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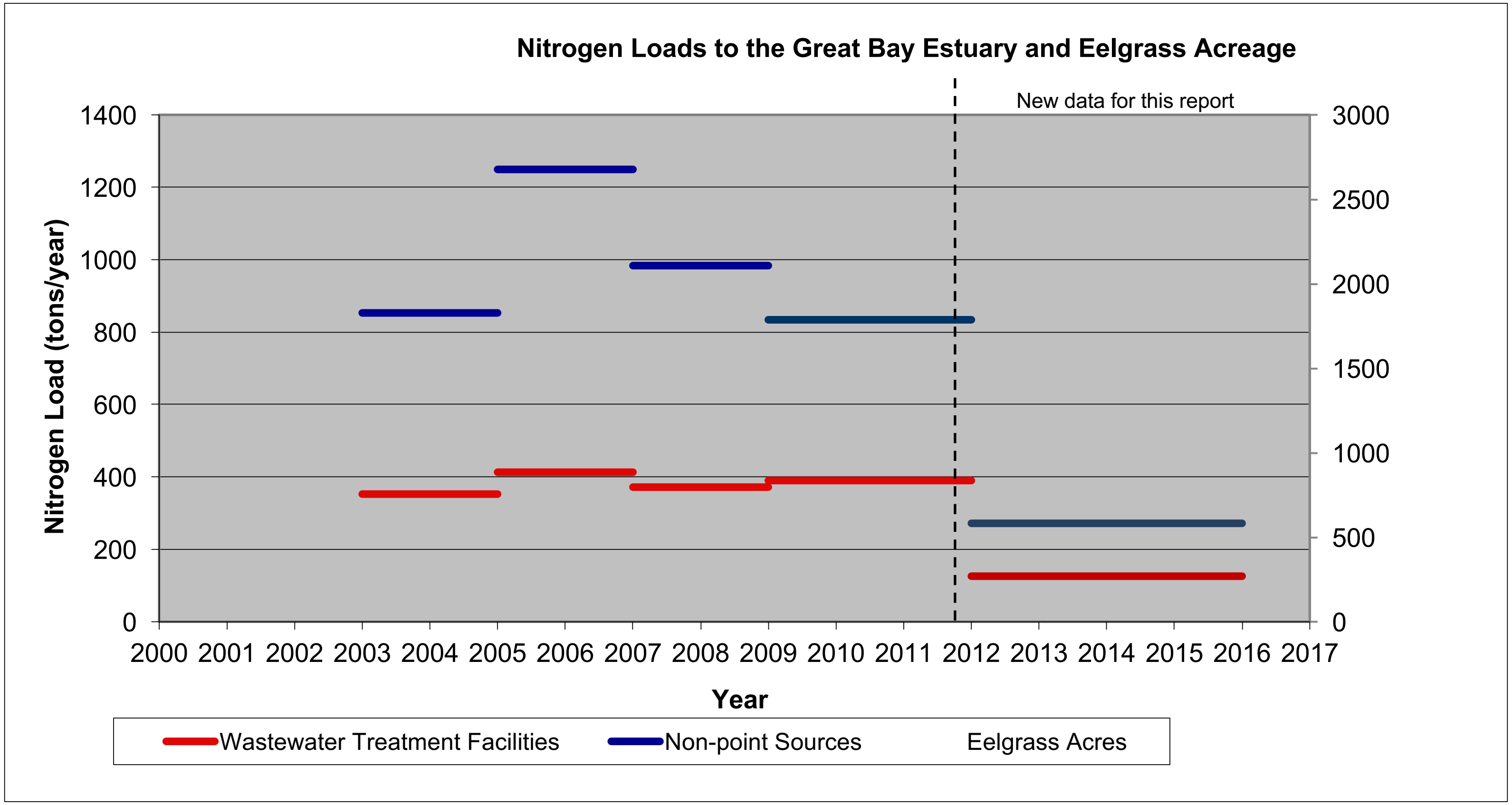
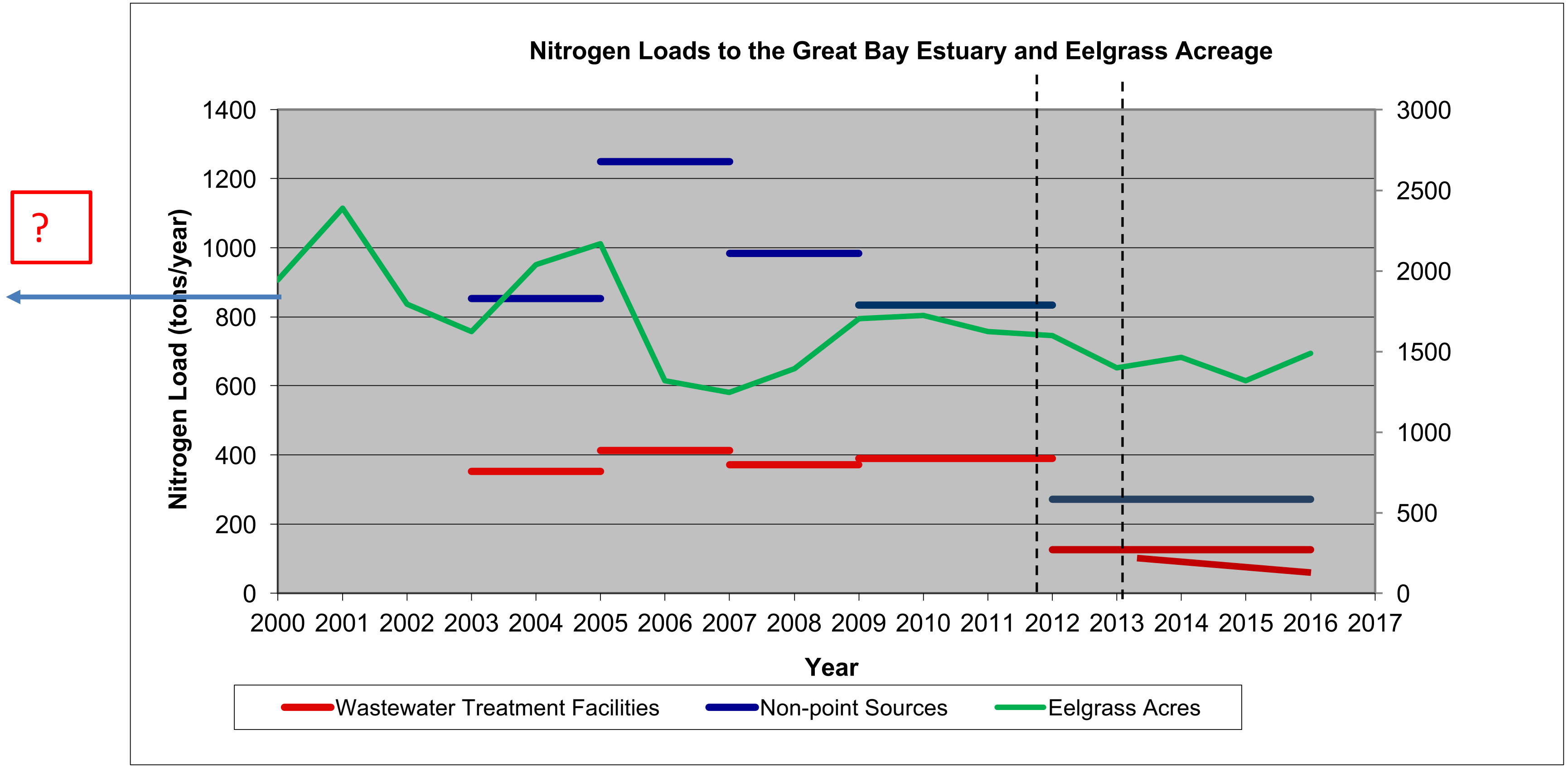
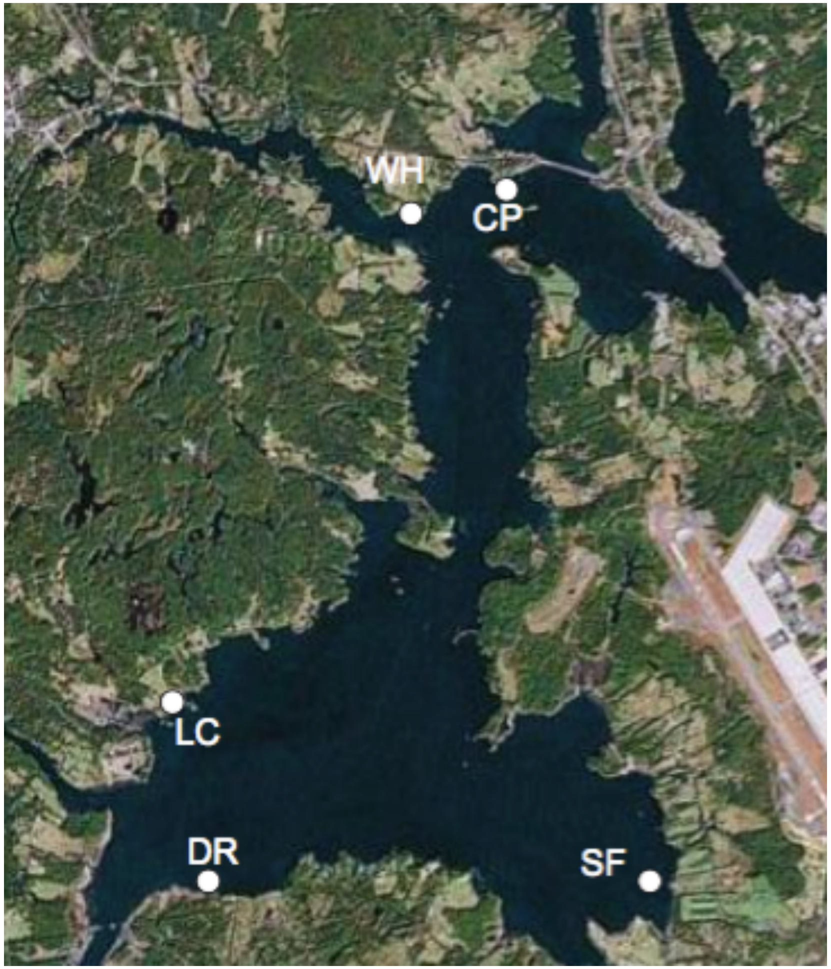
Nitrogen Loading



Nitrogen Loading



Nitrogen Loading

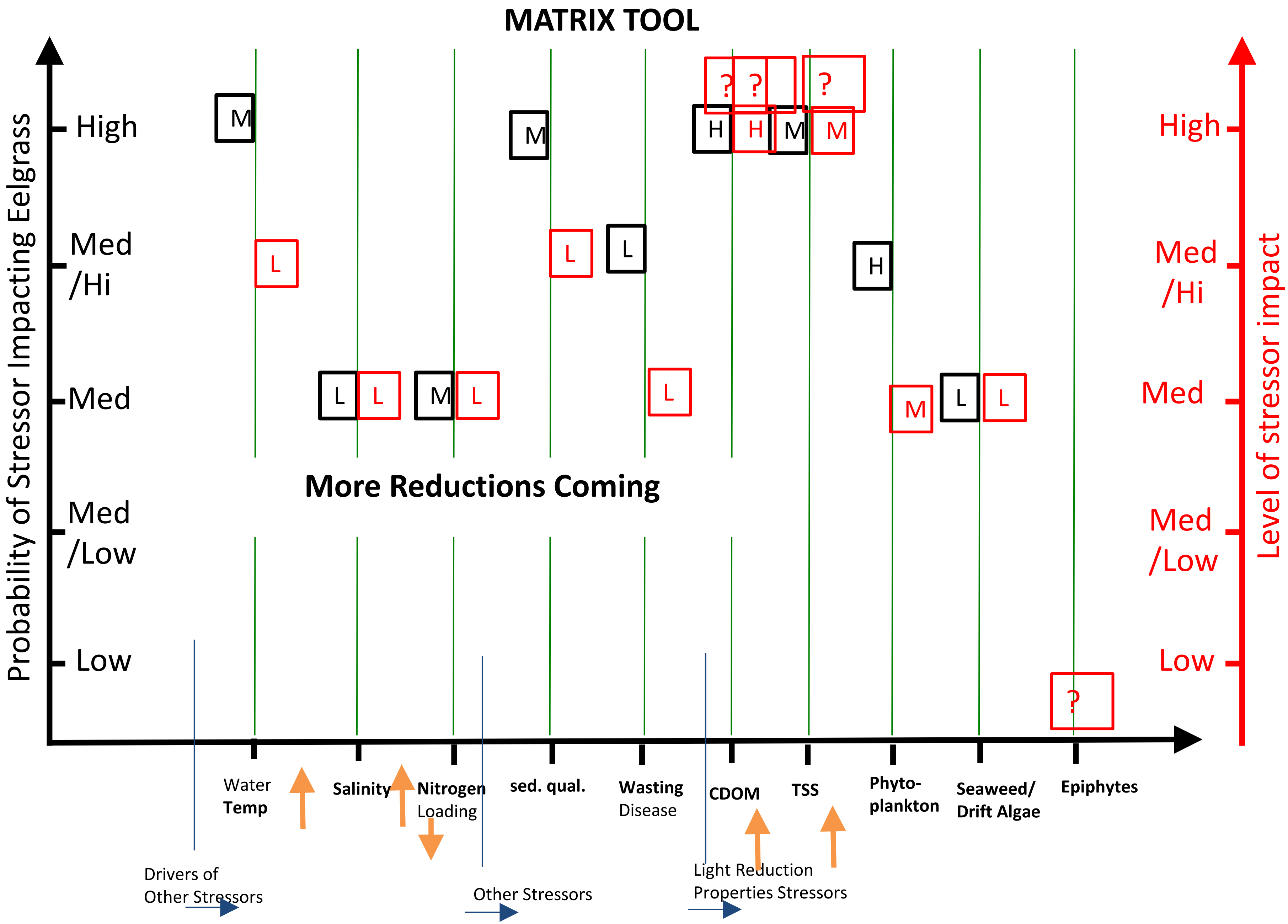


"The mean tissue TN remained between 2.3 and 4.1%, which is above the 2.2% required for unlimited growth in Ulva lactuca" (based on samples collected 2009-2010)

Would we find the same today?

Nettleton, 2011

PREP
Piscataqua Region Estuaries Partnership


MATRIX TOOL
Probability of Stressor Impacting Eelgrass
High
Med /Hi
Med
Med /Low
Low
Level of stressor impact
High
Med /Hi
Med
Med /Low
Low
M
L
L
L
M
L
M
L
L
L
? ?
?
H
H
M
M
H
M
L
L
?
More Reductions Coming
Water Temp
Salinity
Nitrogen Loading
sed. qual.
Wasting Disease
CDOM
TSS
Phyto-plankton
Seaweed/ Drift Algae
Epiphytes
Drivers of Other Stressors
Other Stressors
Light Reduction Properties Stressors

Review of Great Bay Water Quality and Eelgrass Data

John C. Hall

Great Bay Municipal Coalition

May 9/10, 2017

Overview

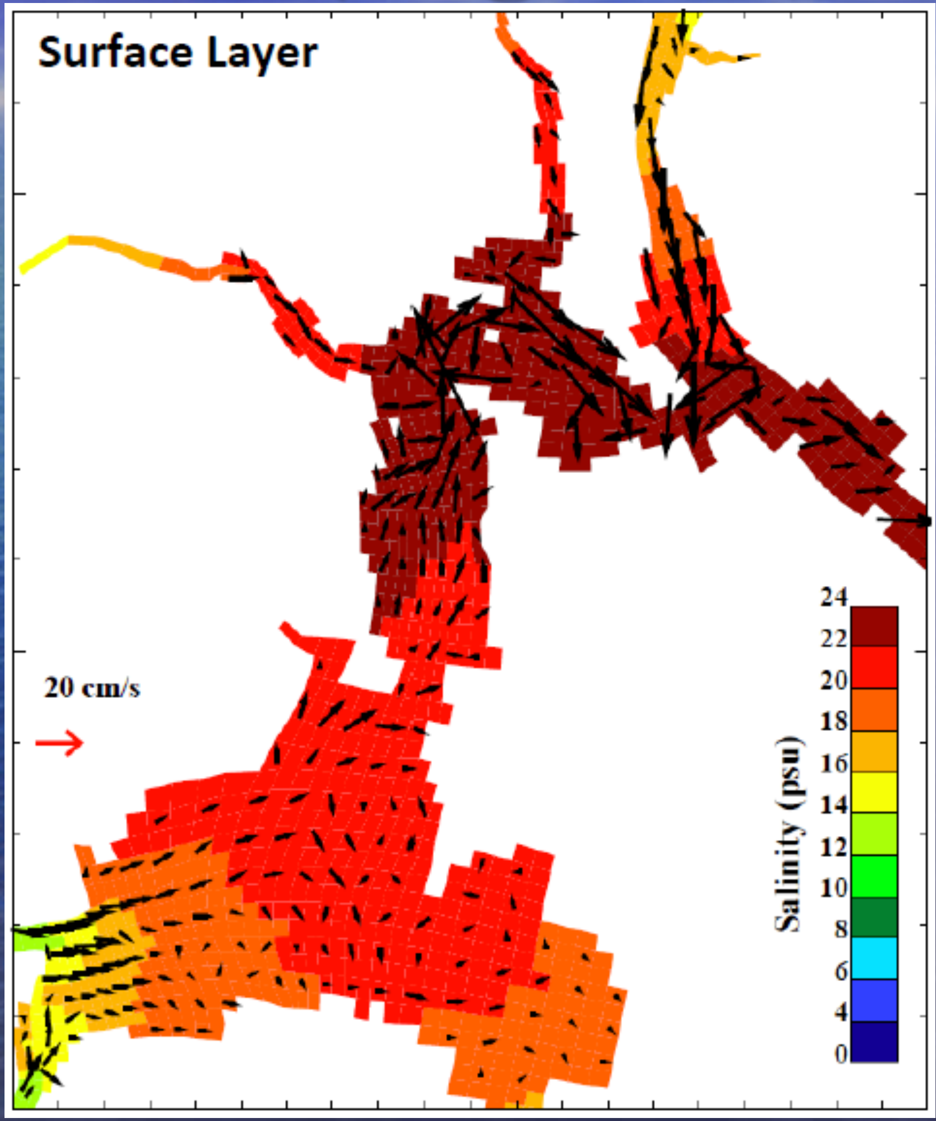
- Great Bay Characteristics
- Eelgrass Metrics
- Changes over Time
  - What this tells us
- Factors Affecting Eelgrass
  - Light Attenuation
  - Other Factors
- East Coast Eelgrass Declines

Unique Great Bay Characteristics

- Shallow
- Large Tidal Range
- Large Tidal Exchange
- High Velocity
- Elevated CDOM

Great Bay Is <u>Not</u> Waquoit Bay or Chesapeake Bay

HDR Hydrodynamic Model – Salinity and Currents (Aug. 3-18, 2010 Ave)



Hydraulic Characteristics

Region	Avg. Residence Time (days)
Great Bay	~ 3
Great Bay – Little Bay	~ 8
Upper Piscataqua River	< 1

Residence time estimated from Hydraulic Model as time to achieve 37% of initial mass. Average reflects spring/neap tides and average/low freshwater inflow.

Short residence time/system transport limits ability of phytoplankton/ floating seaweeds to build up biomass.

Influence of Characteristics on Eelgrass Dynamics

- Reduced light transmittance mitigated by tidal variation/depth
- Eelgrass able to out-compete other plants in GB deeper zones (rooted, early growth cycle, long leaves reach further into photic zone)
- Reseeding difficult in Little Bay and Piscataqua River due to depth and high currents
- Ice scour in GB shallows annual event (reset)

Problem Identification

- Historical monitoring data on eelgrass cover (acreage) suggest cover was *steadily declining*.
- Eelgrass biomass claimed to be declining even more severely.

Are we sure about these facts?

If so, what factors are causing the apparent decline?

Basis for Facts
Aerial Photography

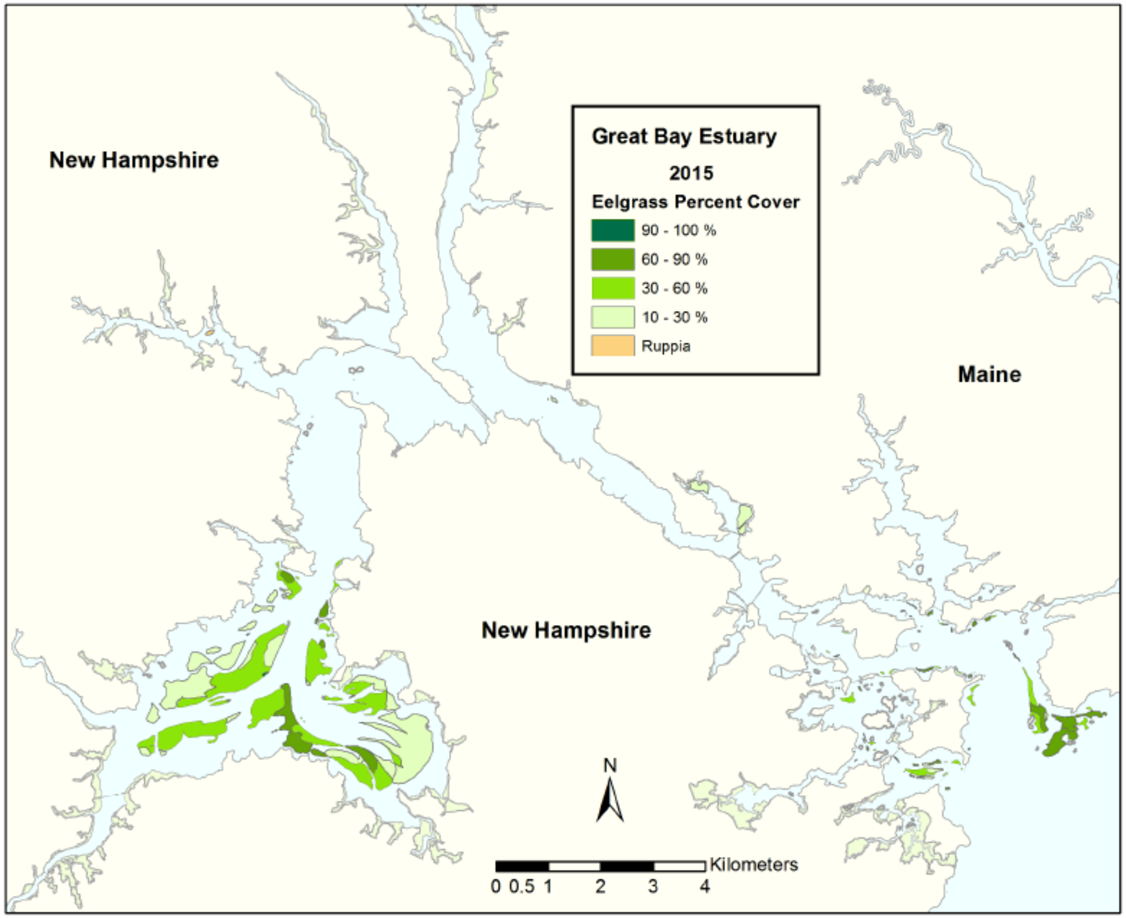


Figure 1. Eelgrass distribution in the Great Bay Estuary based on aerial photography from August 15, 2015 and ground truth surveys.

Photography used to identify:

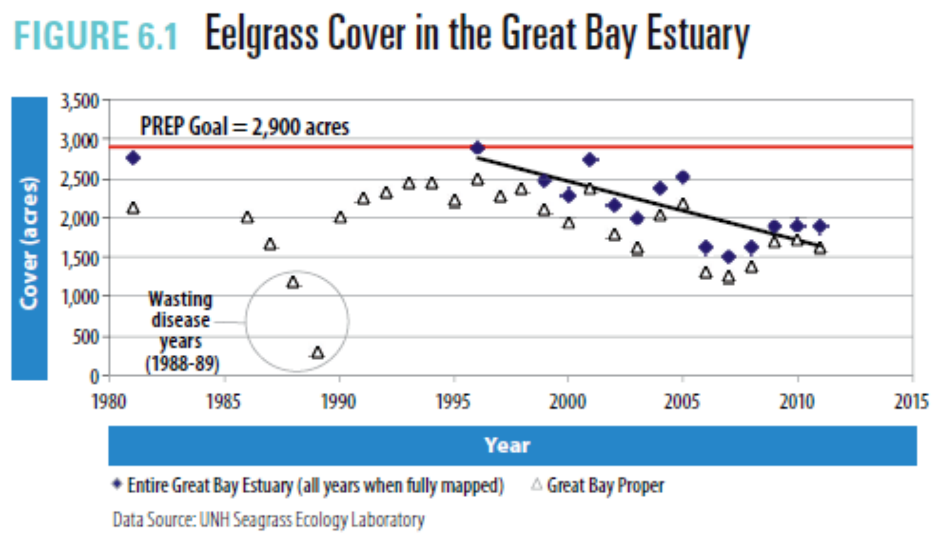
- **eelgrass cover (acres),**
- **density (percent cover).**

Ground truth surveys typically looked at 10% of deep edges.

Biomass estimated using factors (g/m^2) associated with percent cover.

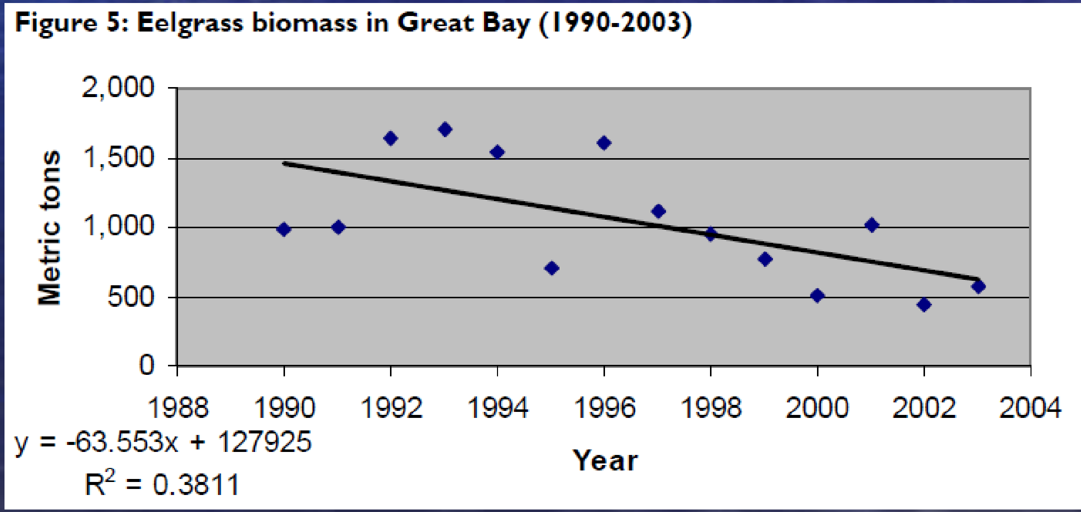
<u>Was seaweed present in the photos</u>?

Reported Eelgrass Trends



Simple linear regressions with time show decreasing acreage and biomass.

PREP SOOE 2013



NHEP Environmental Indicator Report 2006

Biomass Reliability Concerns

- Biomass (g/m^2)
  - Unpublished Data
  - Variability Unknown
  - Poor Comparison with Published Data

Eelgrass Cover Range (%)	Biomass (g/m^2)
0-10	0
10-30	25
30-60	55
60-90	85
90-100	250
(UNH Seagrass Ecology Group)	

Biomass "calculation" significantly influenced by peak density.

Is a biomass increase by a factor of 3 between the 60-90% Range and the 90-100% Range reasonable?

Biomass Literature

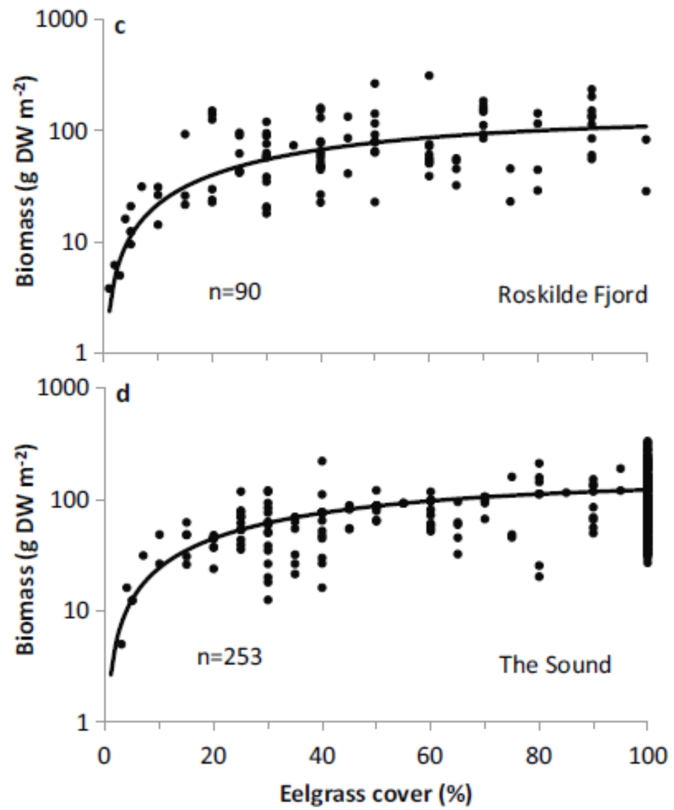


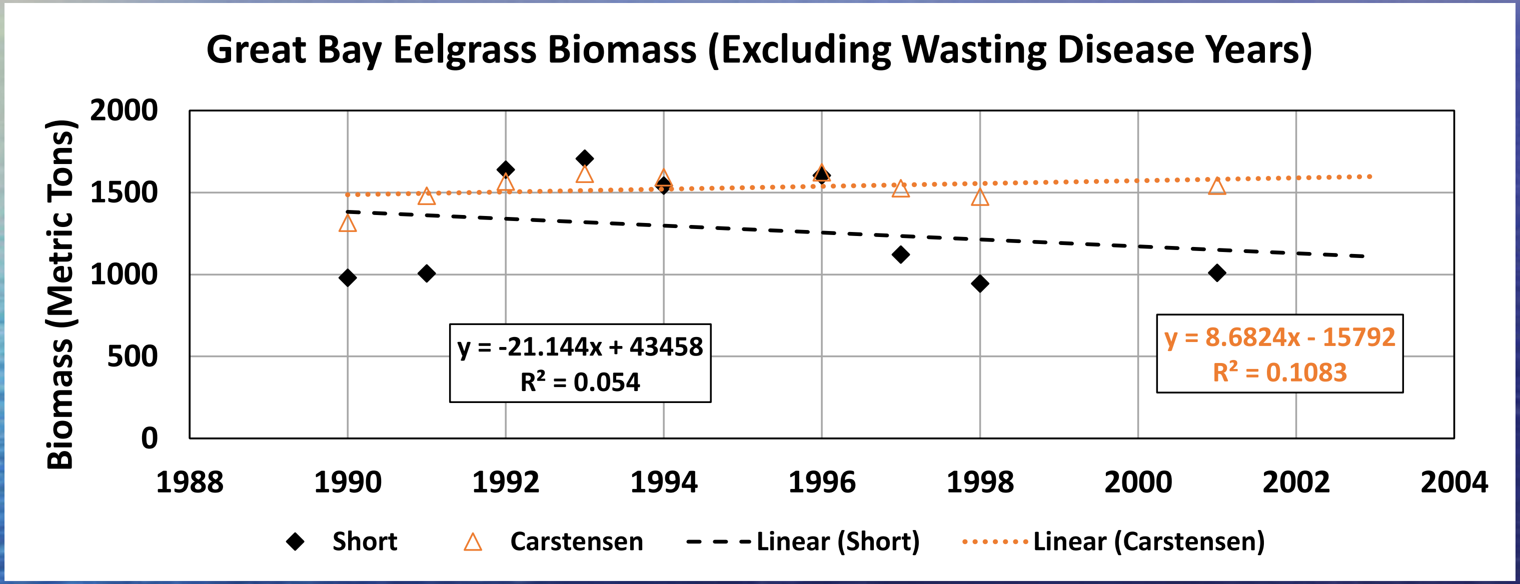
Fig. 6 Marginal relationships between aboveground eelgrass *biomass* and *cover* of four selected sites. Variations in sampling depth, interannual variations in Secchi depth, and month were accounted for by adjusting observations (*dots*) and the modeled relationships (*solid line*) to a mean sampling depth (Table 1) and an average overall months from March to October using the estimated relationship (Eq. 6) and annual means of Secchi depth. The four selected sites had the most biomass observations and a broad span in Secchi depths and eelgrass depth ranges (Table 1)

Carstensen et al.
Estuaries and Coasts (2016)

Measured biomass flattens out above 20% cover (self shading); typical maximum averages ~100 g/m^2 *not* 250 g/m^2.

Contrary to anecdotal biomass reported (e.g., order of magnitude increase from 20% cover to 95% cover; max at 250 g/m^2)

Biomass Trend Uncertainty



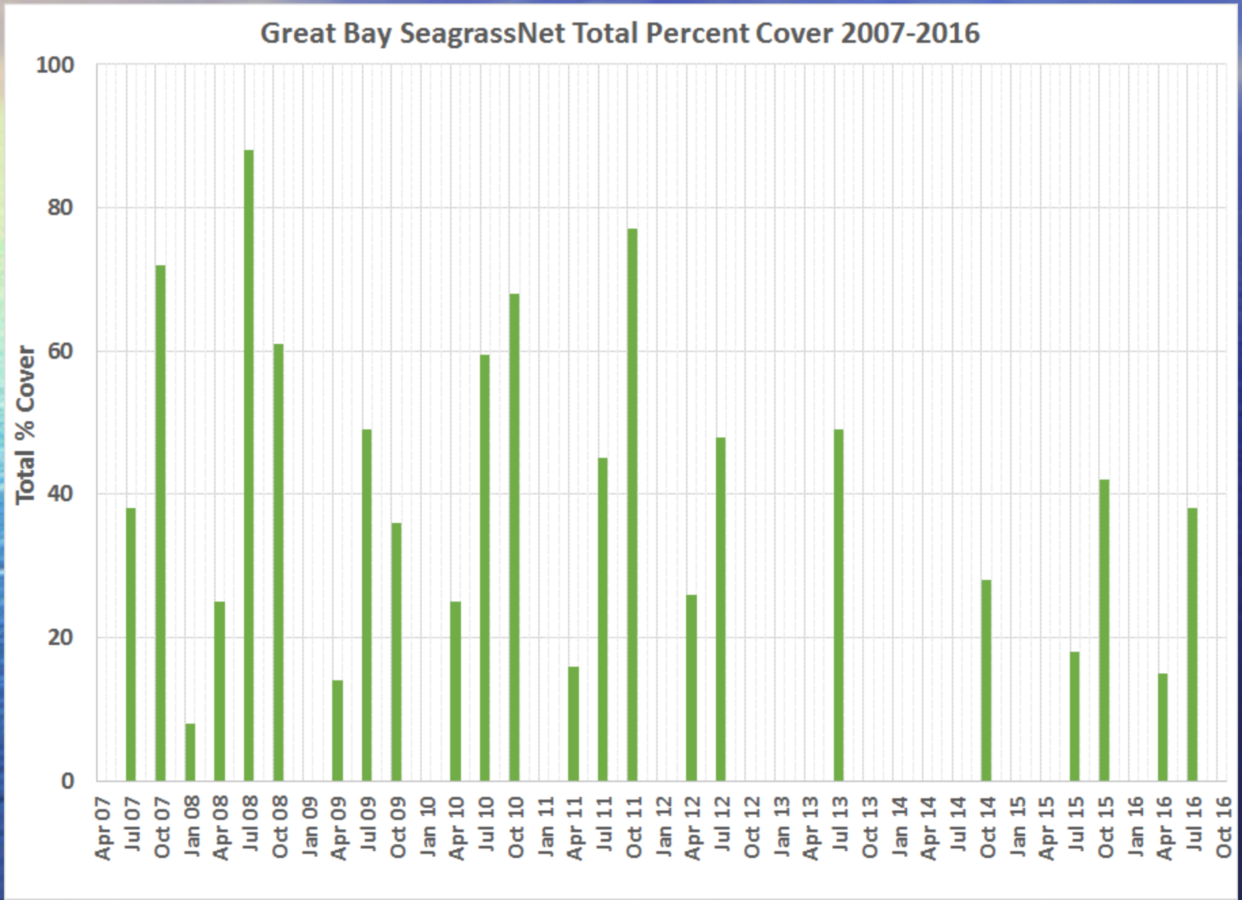
Existing Biomass Estimates for Great Bay
Not Reliable.

Eelgrass Density Concerns

- Aerial photography ranged from August 4 to September 12 in recent (2002 – 2015) surveys.
- *Peak year photos/backup never publicly available despite repeated requests for access*
- Time to maximum density varies significantly within this period (Aug 1 – Oct 15).

Starting conditions and timing of measurement greatly influences the estimated density

Eelgrass Peak Density Timing



SeagrassNet Results for Great Bay

- Peaks observed in late July or mid-October
- No measurements in August or September when aerial photographs taken

<u>Timing of peak depends on conditions during growing season</u>

Variability in Time to Peak Density (Percent Cover of Quadrats)

Year	Late July	Mid October	Change
2007	37	70	+89
2008	86	60	-30
2009	45	35	-22
2010	58	65	+12
2011	44	73	+66
2015	15	40	+167

From Aug. 1 – Oct. 20 peak cover may vary by factor of ~3
2007, 2011, 2015 much "healthier" than reported.

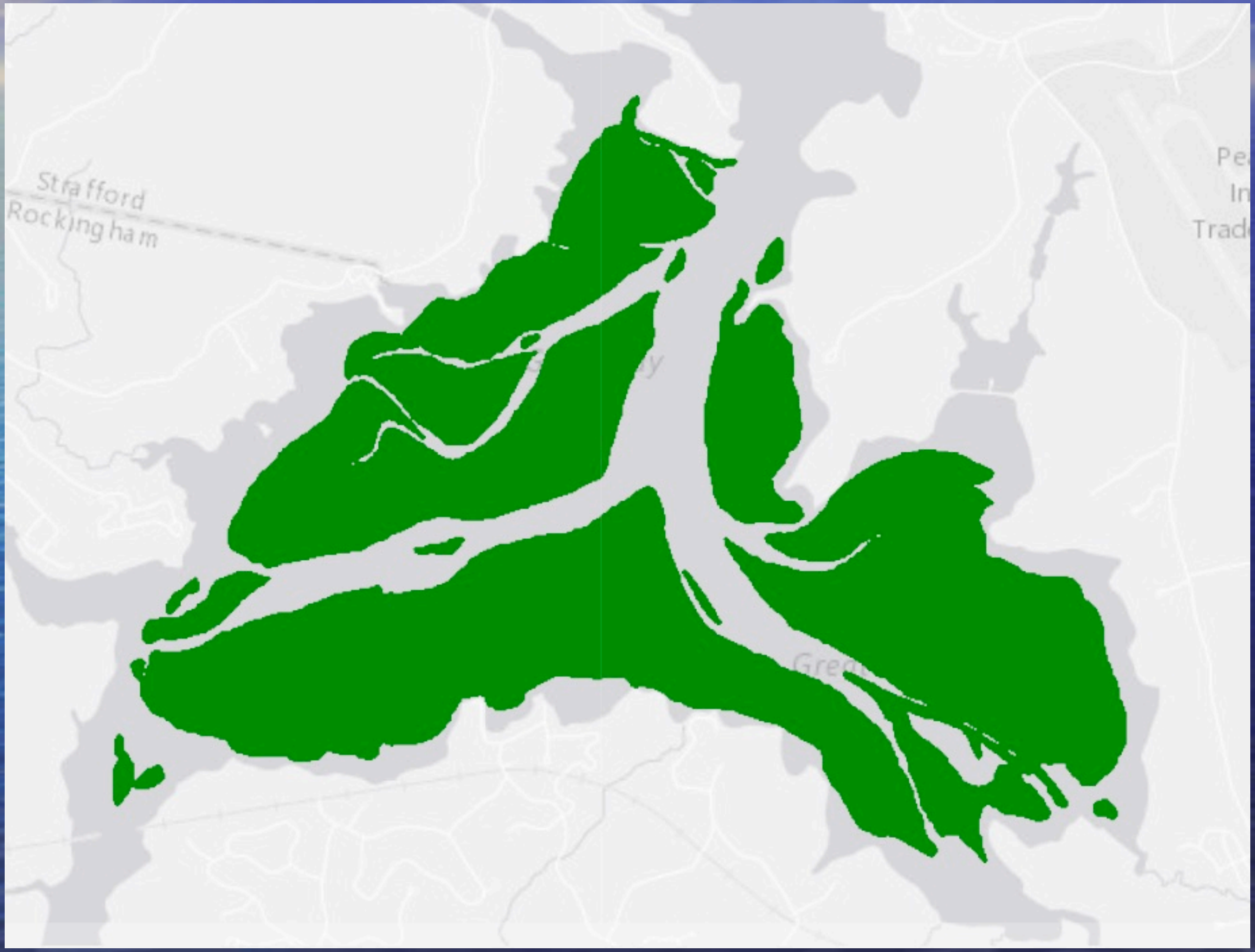
Estimating eelgrass density based on a single grab sample (aerial photograph) subject to significant error!

Eelgrass Acreage Concerns

- Aerial method subject to significant error/uncertainty because cover estimates based on photos from *3,000 feet with limited ground truth measurements*.

  "It is not possible to reliably distinguish between eelgrass and macroalgae, or between different species of other seagrasses, using aerial imagery." (USACoE, 2016)

1996 Eelgrass Cover?



Conclusions Regarding Mapped Eelgrass Acreage

- Cannot call all mapped acres eelgrass based on aerial photography
- Shallower areas (~40% of GB) are likely confounded by seaweeds (SeagrassNet)
- Overflights later in season most confounded by seaweeds (See, Burdick/ Nettleton).

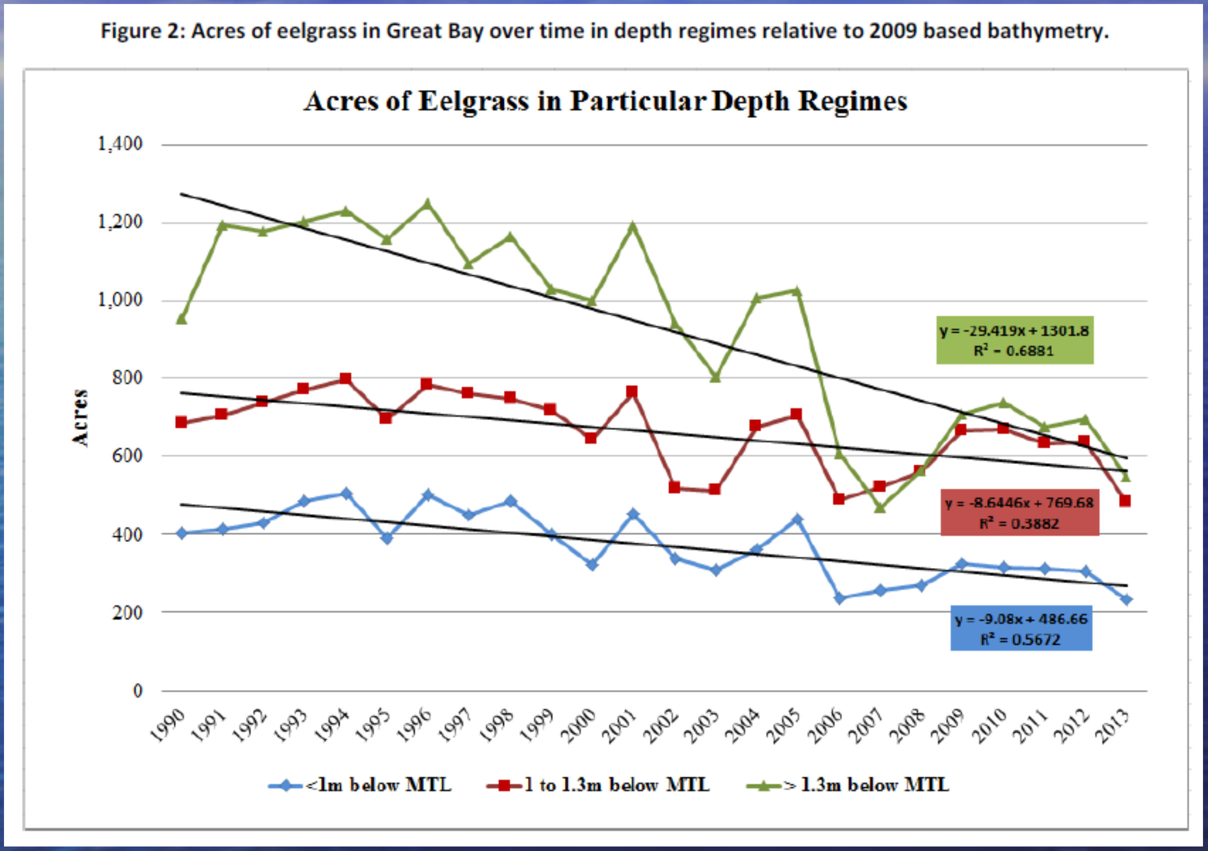
SOOE Needs to Acknowledge this Uncertainty!

Indisputable Facts

- Eelgrass acreage has declined in Great Bay *since 2006 at all depths*
- Eelgrass acreage in Little Bay never recovered from 1989 wasting disease outbreak.

The Issue - What Caused This To Occur?

DES Eelgrass Cover with Depth Trend Analysis



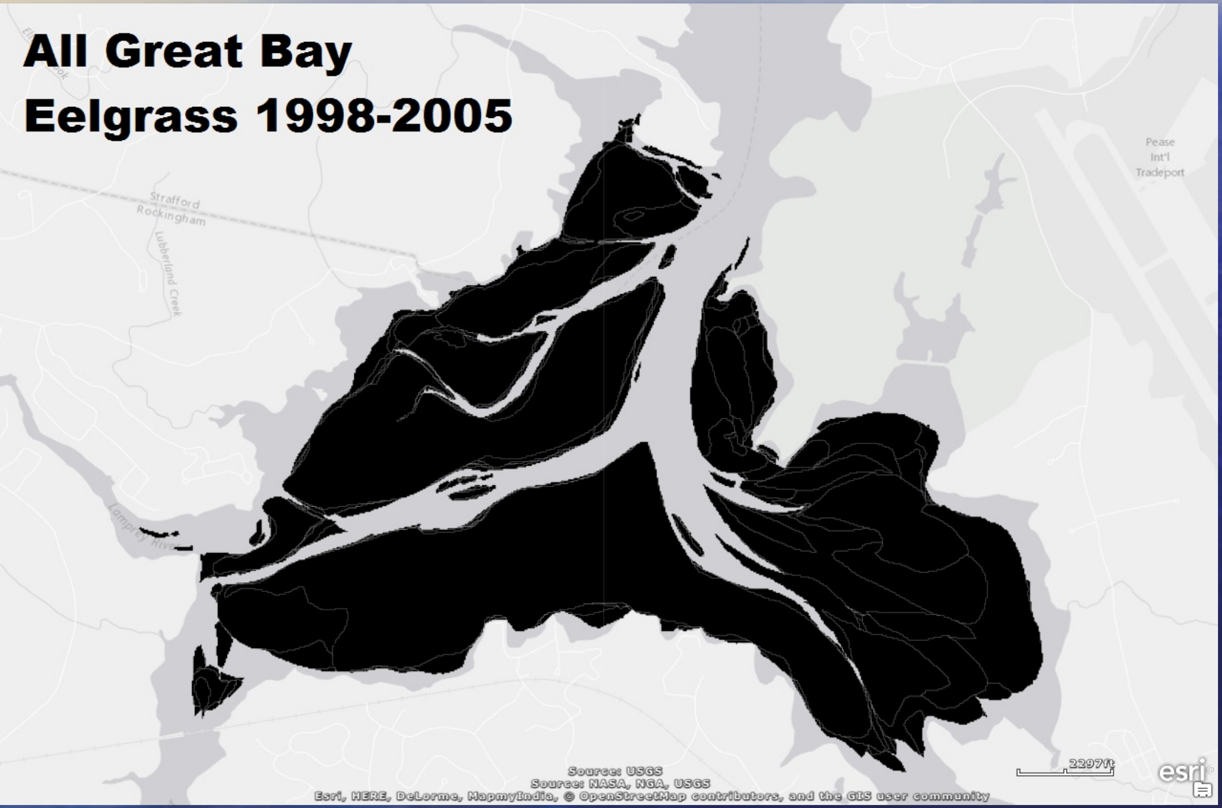
NH DES Response to Public Comment on Draft 2014 303(d) List
Memorandum from M. Wood, April 15, 2016

Key Information to Consider in Evaluation of Trends

- Multiple Wasting Disease Events
  - Major Outbreak: 1931-32 (wiped out East Coast)
  - Major Outbreak: 1984 (Little Bay, Piscataqua)
  - Major Outbreak: 1988 – 1989
  - Other Outbreaks: 1995, 1999-2000, 2002-2003
- Mother’s Day Storm (2006)

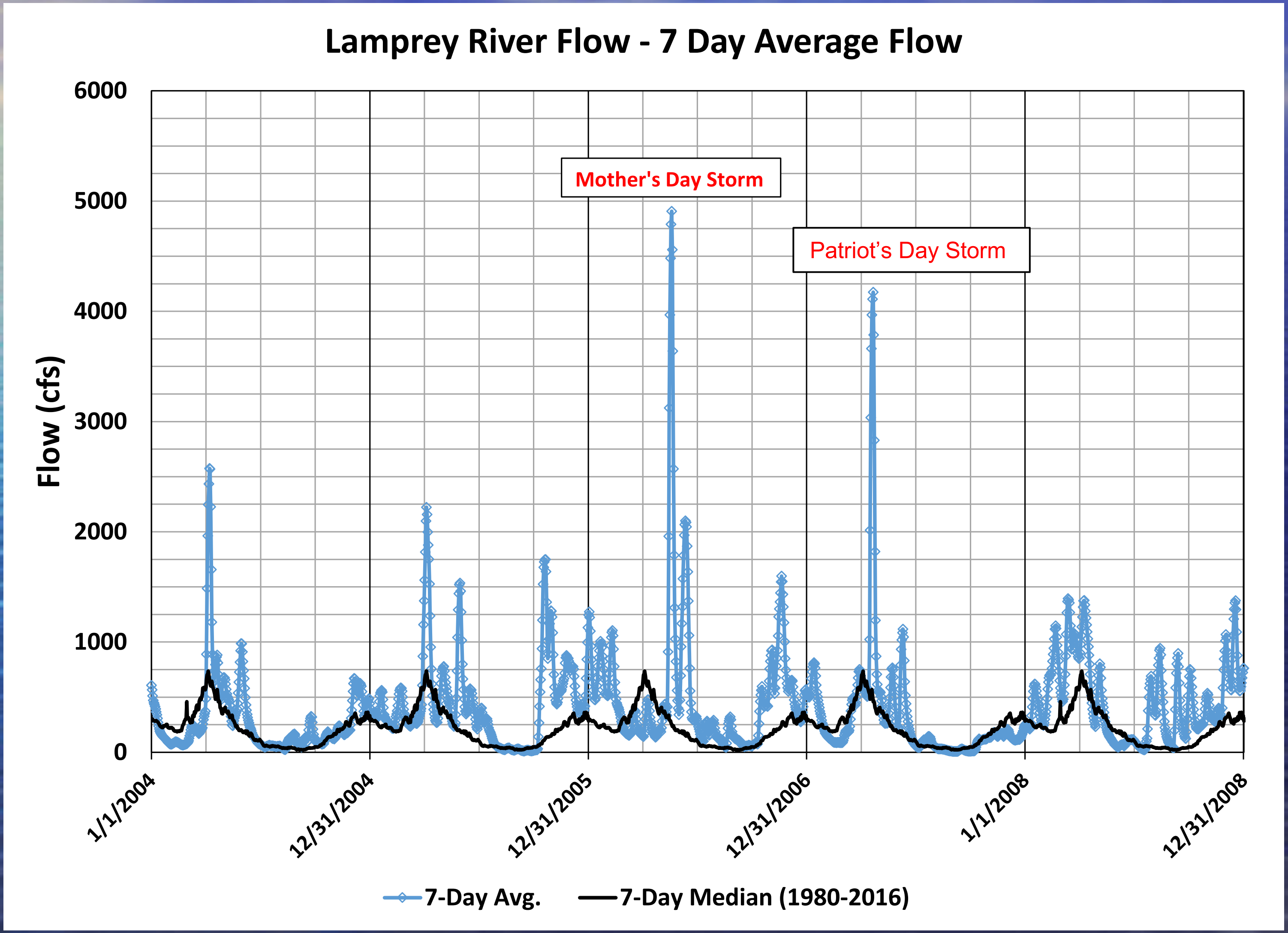
Prior PREP reports failed to recognized any wasting disease outbreaks other than 1988/89 and ignored MDS impacts

Eelgrass Cover Analysis
(Pre-2006 Mother's Day Storm)

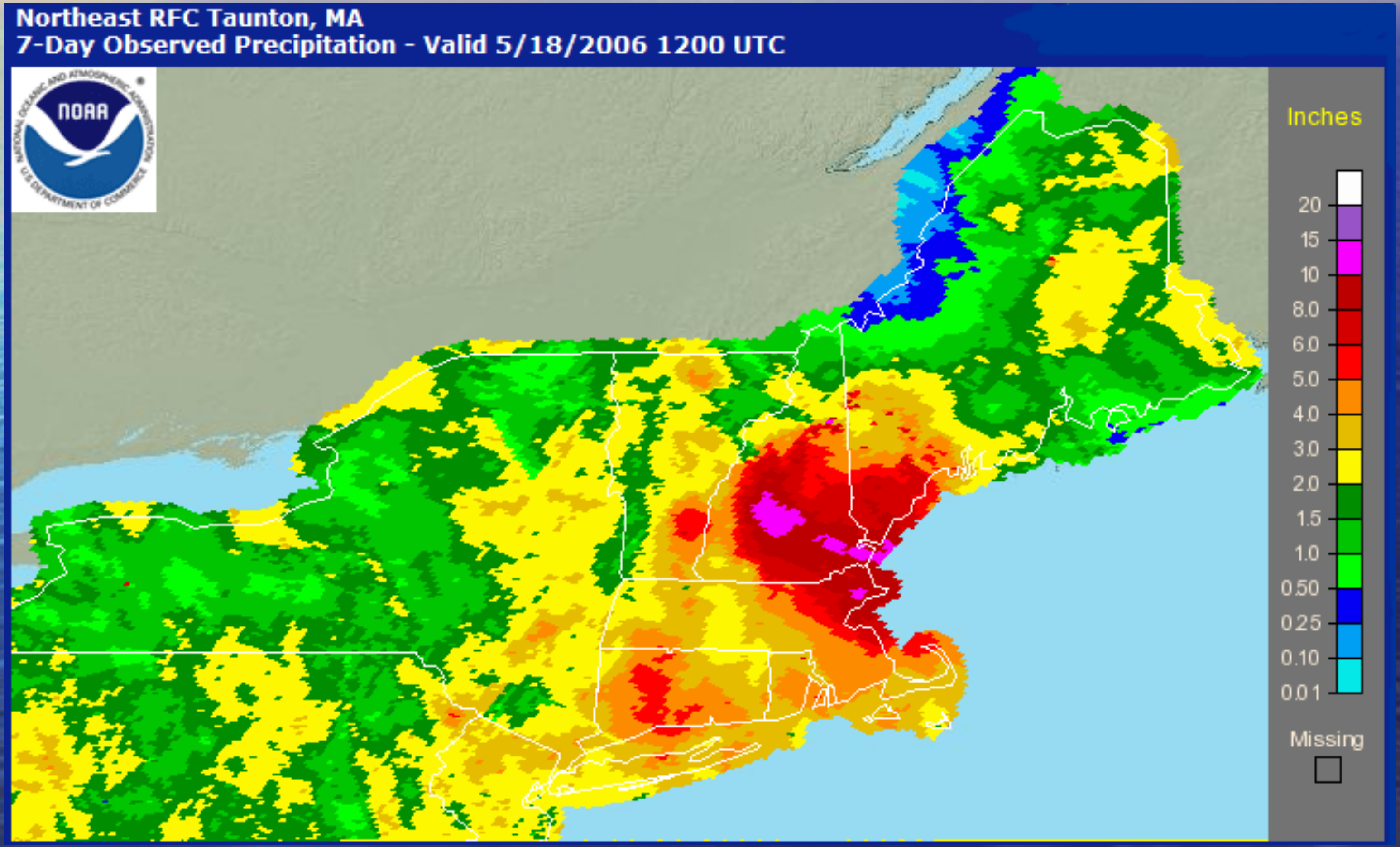


"Eelgrass" able to grow to measurable cover in all habitable areas of Great Bay except the deepest central channels.

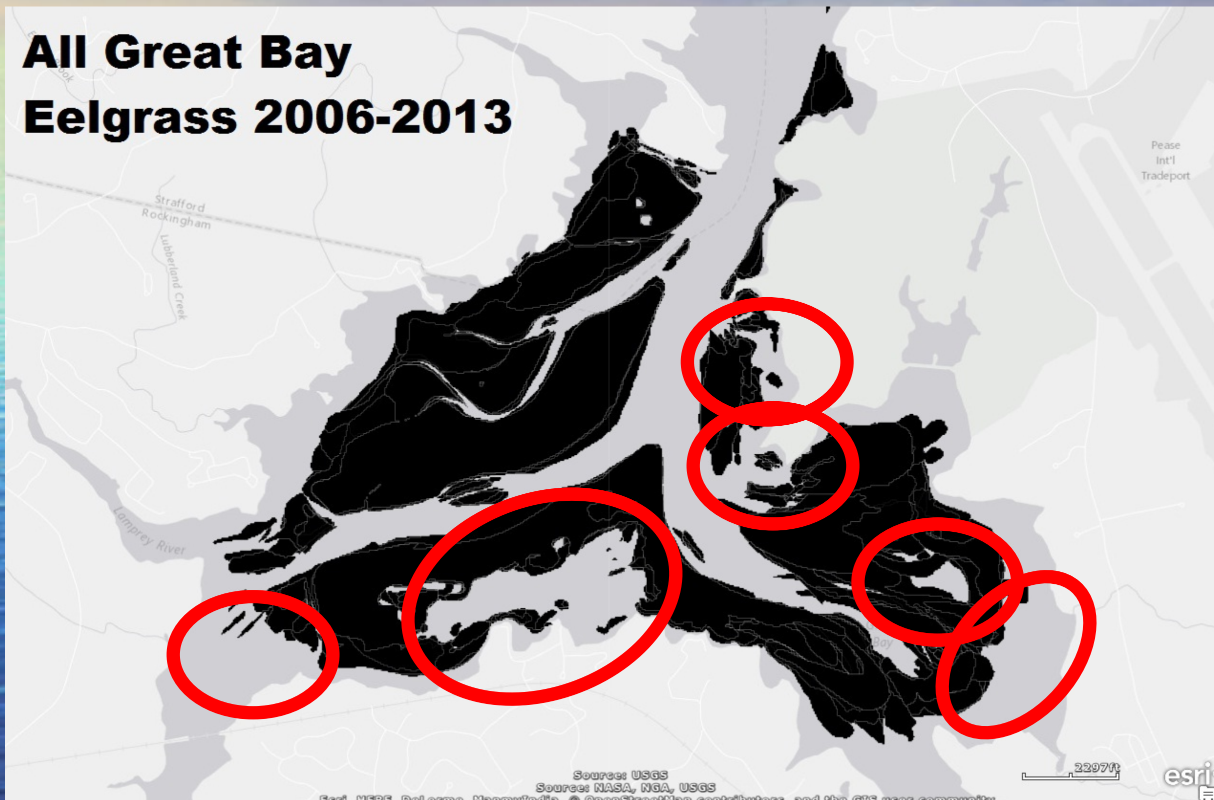
Mother's Day Storm



Extreme Flood in Watershed



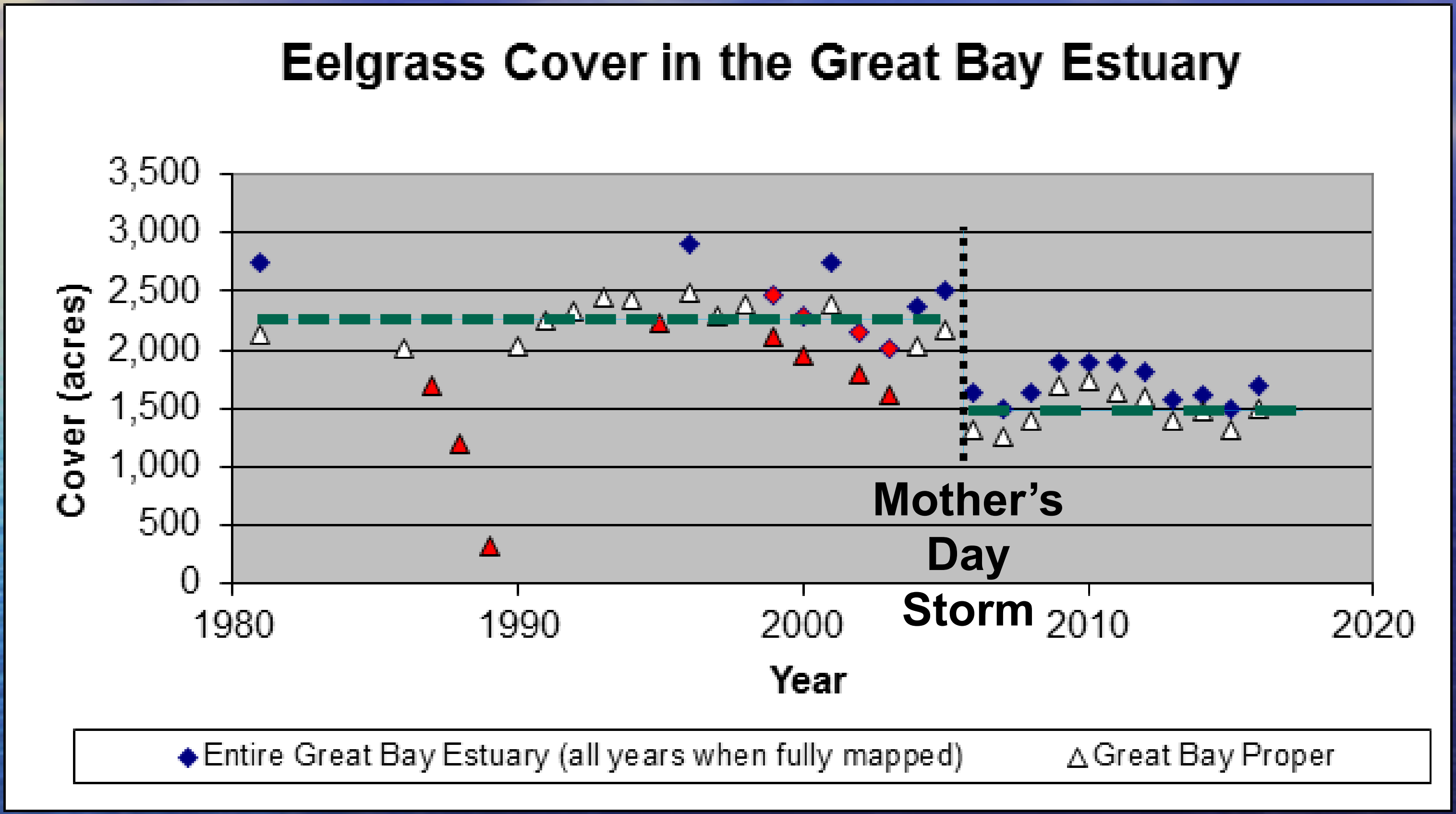
Eelgrass Cover Analysis
(Post-2006 Mother's Day Storm)



Since 2006, Eelgrass have not grown to measureable cover in several shallow areas (totaling >300 acres) that were previously eelgrass meadows.

The eelgrass losses are mostly in the shallows!!! Light???

Eelgrass Acres over Time



Red fill indicates year with known wasting disease outbreak.

Trend lines for years <u>without wasting disease</u>

Conclusions Regarding Eelgrass Dynamics

- **2006 Marks Boundary for New Growth Pattern**
  - Historical acres not realistic management goal; 1996 coverage not a reasonable basis for comparison
  - Over 300 acres in *shallows* now have "issues" for supporting eelgrass

Likely that MDS brought in huge sediment "dump" impacting eelgrass reseeding viability

Factors Known to Affect Eelgrass

- Light
  - Phytoplankton
  - CDOM/NAP (rainfall)
  - TSS (wind)
  - Macroalgae
  - Epiphytes
  - Depth
- Wasting Disease
- Geese
- Extreme Storms
- Ice Scour
- High Temperature
- Macroalgae (competition)
- Sediment (habitat)

<u>Other Potential Factors</u>

- Other Pollutants (herbicides)
- Invasive Species
- Other biologicals

Available Light
Is <u>Not</u> the Issue:

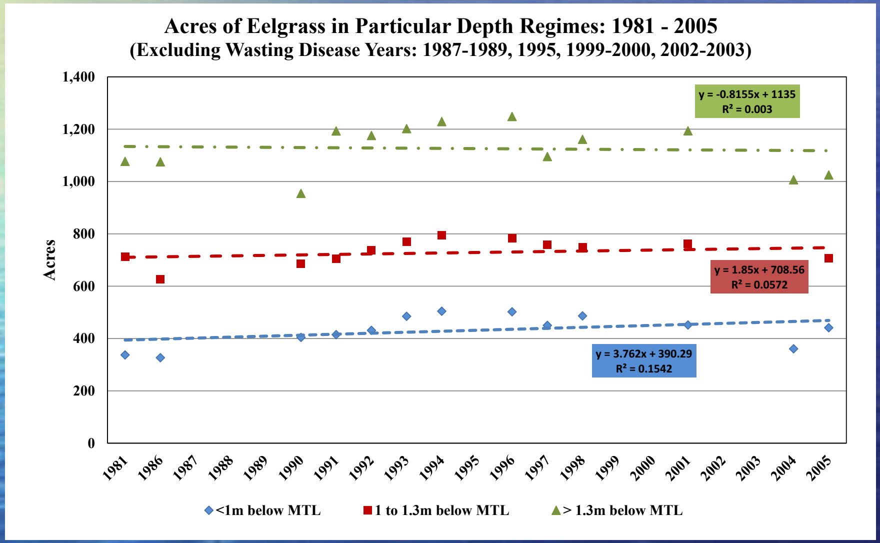
Eelgrasses Have Grown Robustly at All Depths

Deepest Grasses Most Dense

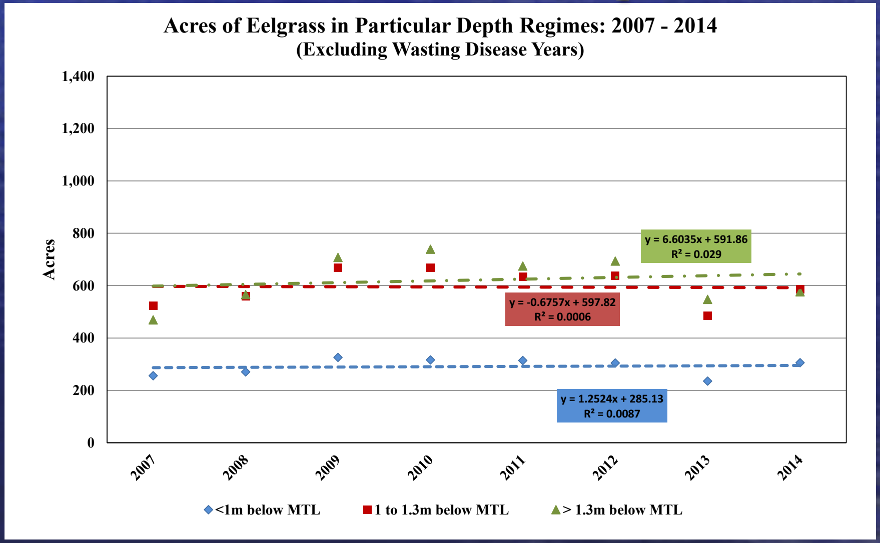
Deepest Grasses Most Resilient

DES Eelgrass Acreage - Depth Analysis

Evaluation revised to exclude ALL periods of known wasting disease



After Mother's Day Storm
Eelgrass cover relatively stable from 2007 – 2014 at each depth zone.



Before Mother's Day Storm
Eelgrass cover relatively stable from 1981 – 2005 at each depth zone.

Light Attenuation

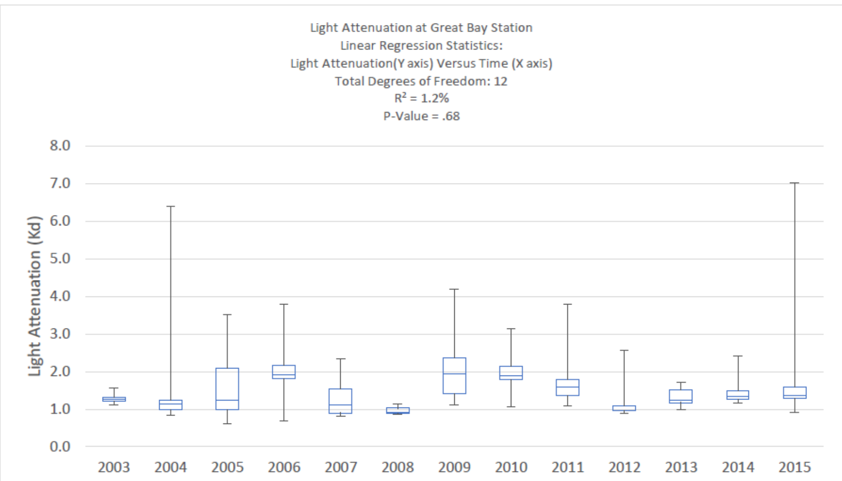


Figure 1. Box and whisker plot of monthly light attenuation sampling at low tide from 2003 through 2015, looking only at months April through December. Values under 1.0 are The bottom of the boxes represent first quartile (where 25% of the data occur); the top of the box is the third quartile (where 75% of the data occur). The lower and upper 25% are represented by the "whiskers." The horizontal line in the box is the median. Note that 2008 only has data for the months August through October.

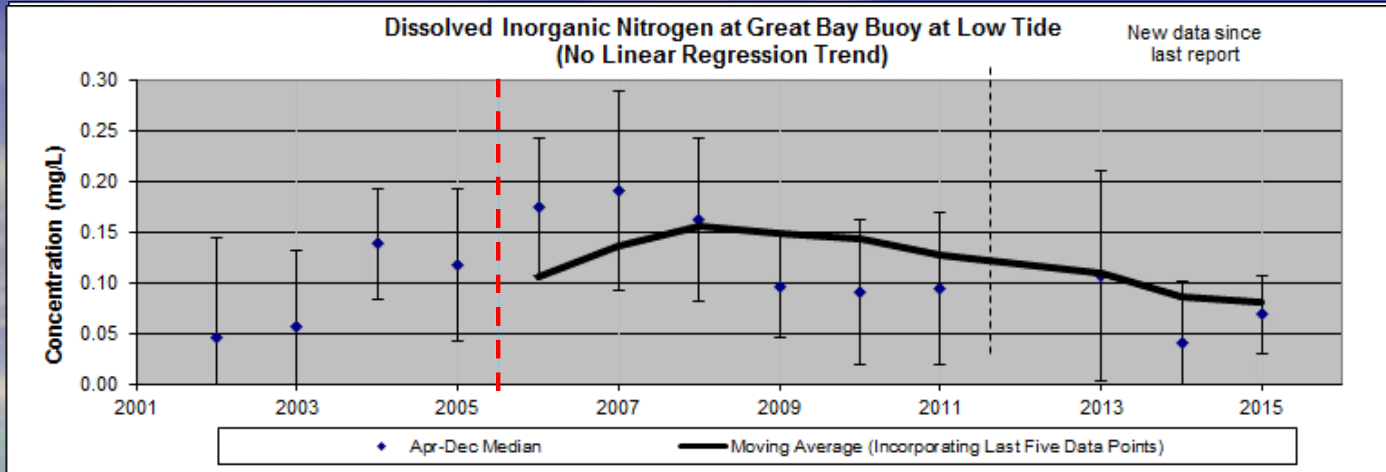
Minor variation in eelgrass cover even though large variation in light transmittance.

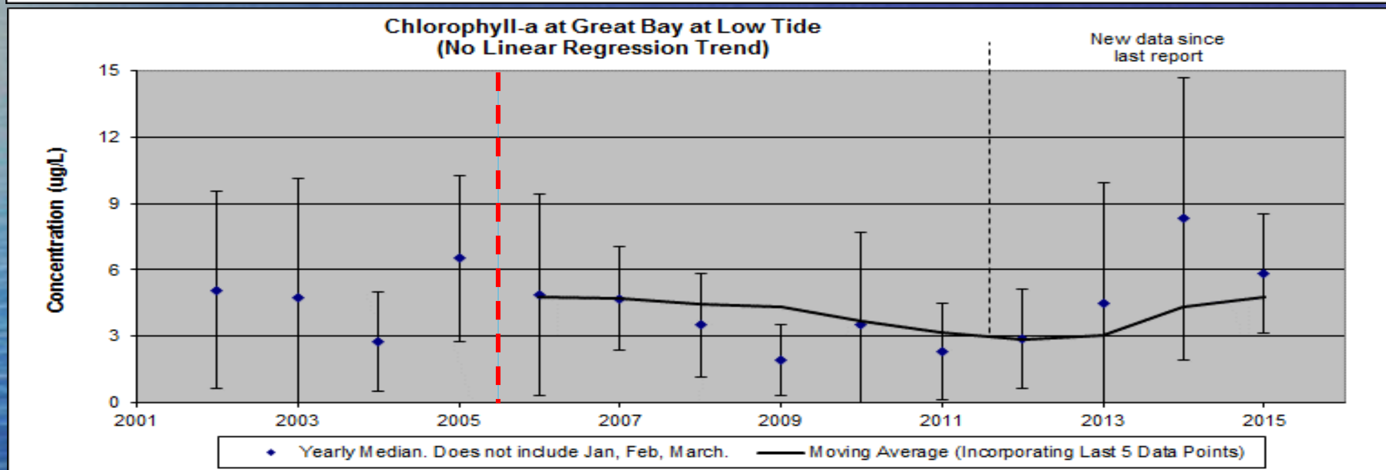
Transmittance at 1.0 meter depth

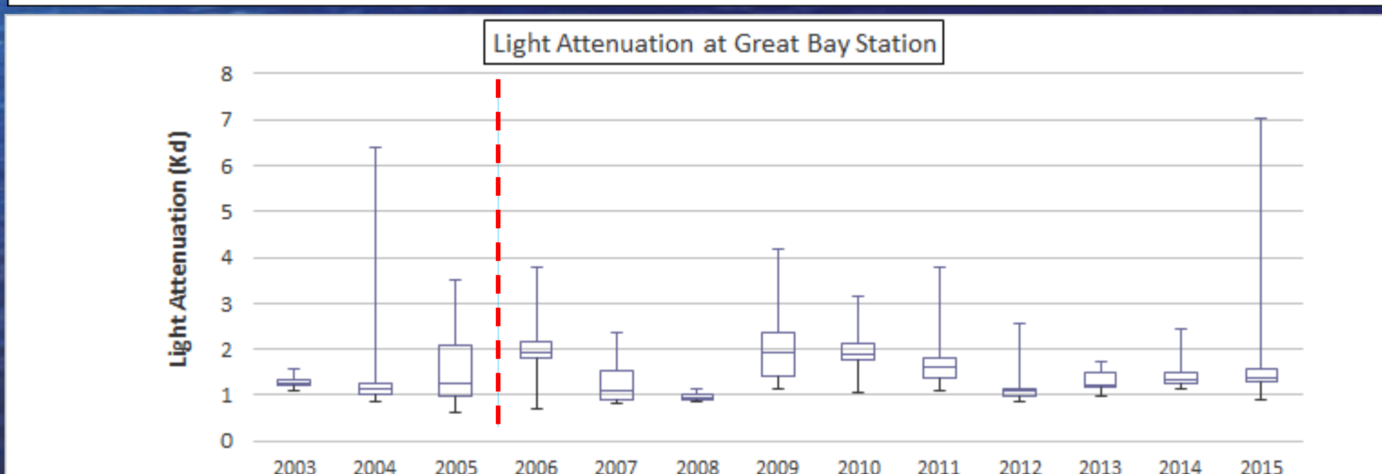
Year	K_d	Transmittance	Acres
2008	0.9	40.7%	1,395
2009	1.9	15.0%	1,701
2010	1.8	16.5%	1,722
2011	1.6	20.2%	1,625
2012	1.0	36.8%	1,599

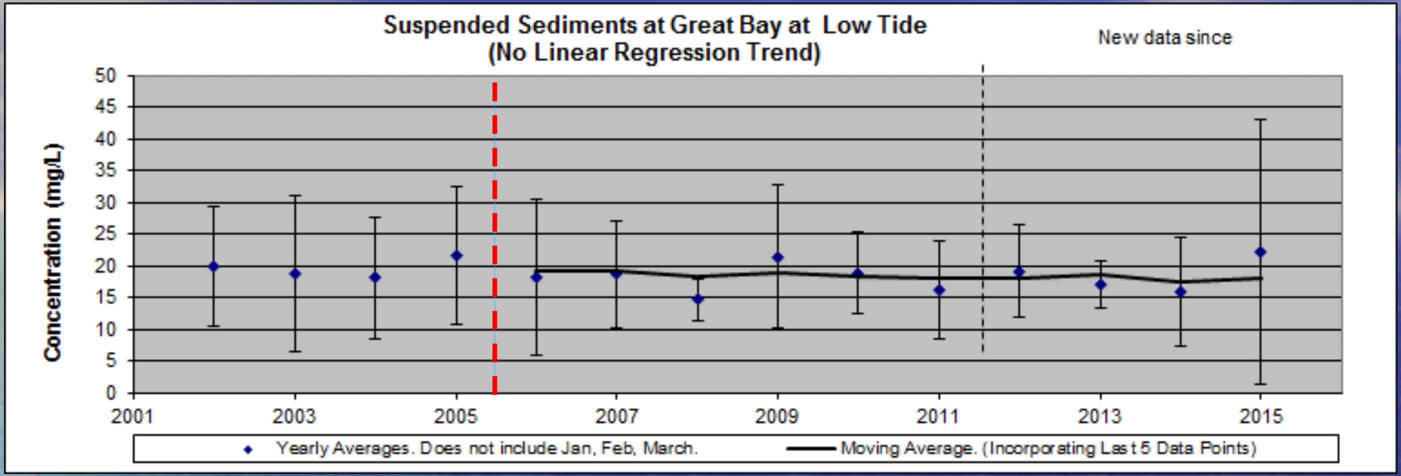
Factors Influencing Light

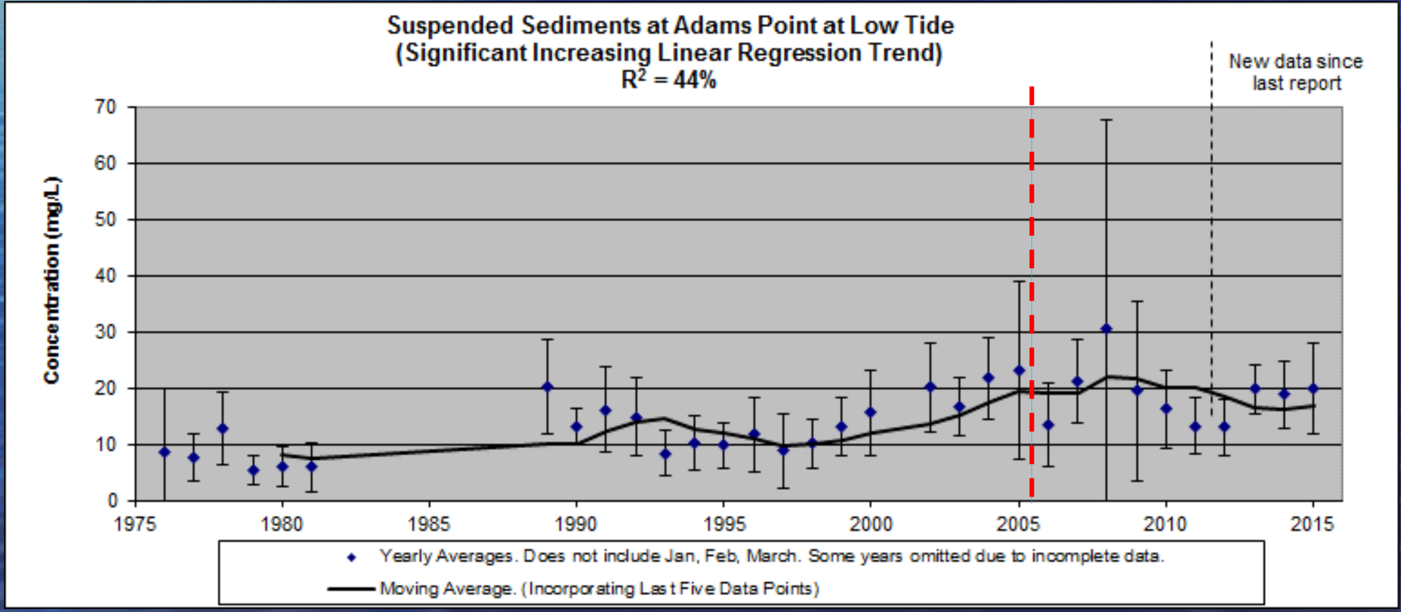
- Phytoplankton – decrease light transmittance as chlorophyll-a concentration increases. Confirmed minor contributor to extinction coefficient.
- CDOM/NAP/TSS – decrease light transmittance as concentration increases. Significant contributors to extinction coefficient. Primary source of CDOM and NAP is terrestrial runoff.
- Macroalgae – shade out Eelgrass *when leaves cover Eelgrass blades*.
- Epiphytes – shade out Eelgrass blades from direct attachment onto blades.
- Water Depth/Tidal Variation – influences degree of incident light reaching Eelgrass blades.


Dissolved Inorganic Nitrogen at Great Bay Buoy at Low Tide
(No Linear Regression Trend)
New data since last report
Concentration (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2001
2003
2005
2007
2009
2011
2013
2015
Apr-Dec Median
Moving Average (Incorporating Last Five Data Points)


Chlorophyll-a at Great Bay at Low Tide
(No Linear Regression Trend)
New data since last report
Concentration (ug/L)
15
12
9
6
3
0
2001
2003
2005
2007
2009
2011
2013
2015
Yearly Median. Does not include Jan, Feb, March.
Moving Average (Incorporating Last 5 Data Points)


Light Attenuation at Great Bay Station
Light Attenuation (Kd)
8
7
6
5
4
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015


Suspended Sediments at Great Bay at Low Tide
(No Linear Regression Trend)
New data since
Concentration (mg/L)
50
45
40
35
30
25
20
15
10
5
0
2001
2003
2005
2007
2009
2011
2013
2015
Yearly Averages. Does not include Jan, Feb, March.
Moving Average. (Incorporating Last 5 Data Points)


Suspended Sediments at Adams Point at Low Tide
(Significant Increasing Linear Regression Trend)
R^2 = 44%
New data since
last report
Concentration (mg/L)
70
60
50
40
30
20
10
0
1975
1980
1985
1990
1995
2000
2005
2010
2015
Yearly Averages. Does not include Jan, Feb, March. Some years omitted due to incomplete data.
Moving Average. (Incorporating Last Five Data Points)

Canada Goose Grazing in Shallows

Over-winter grazing by a flock of 100 Canada Geese decimated a 25 acre eelgrass meadow at Fishing Island (Portsmouth Harbor) with little subsequent recovery.

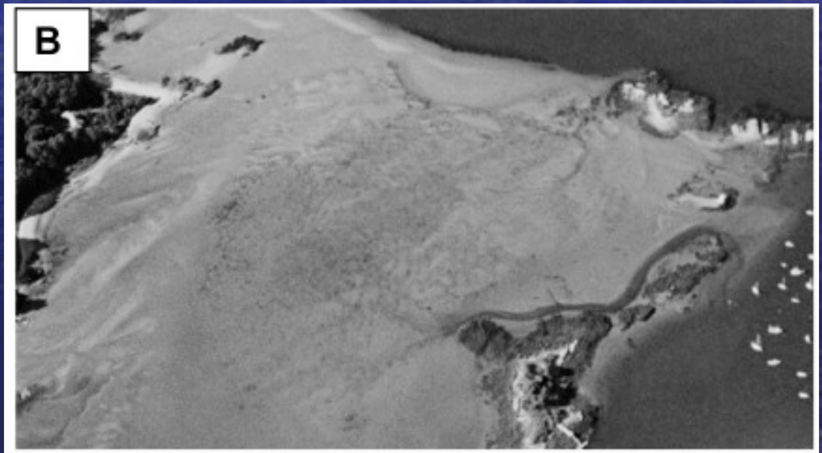


Fig. 3. *Zostera marina.* Aerial photographs of the Fishing Island eelgrass meadow, from (A) August 2001 and (B) August 2002. The dark area on the mud-flat is the eelgrass

Rivers and Short. 2007. Marine Ecology Progress Series 333

Weather

- **Extreme Storm Events (Yes)**

  2006 Mother's Day Storm (associated with decreases in eelgrass acreage that have persisted for a decade)

- **Changes in Rainfall Pattern?**

  Top 4 rainfall years over last 120 years occurred between 2005 – 2011 (contribute to increased CDOM/NAP loads and overall water clarity)
  Timing of rainfall increase most important (May-June)

- **Temperature (?; Yes – Ice)**

  Winter of 2014 – 2015 was one of coldest in the past 100 years (associated with eelgrass decline observed in 2015 SeagrassNet monitoring).

  Waters warming during growing season (shallows most affected).

Macroalgae

- What we know
  - Most historical data anecdotal
  - Nettleton et al. (2011)

    Tracked seasonal growth on mud flats (2008 – 2010)

    Measured tissue nitrogen
  - Burdick et al. (2017)

    Looked at types of macroalgae with depth
  - SeagrassNet Surveys (2007 – 2016)

    Tracked seasonal growth with depth

Nettleton et al. (2011)

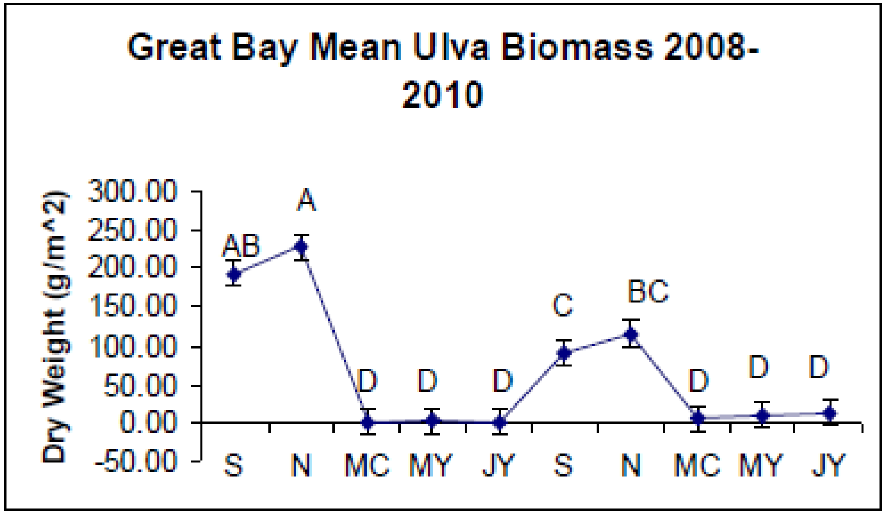


Figure 8 Great Bay *Ulva* monthly mean biomass across five study sites

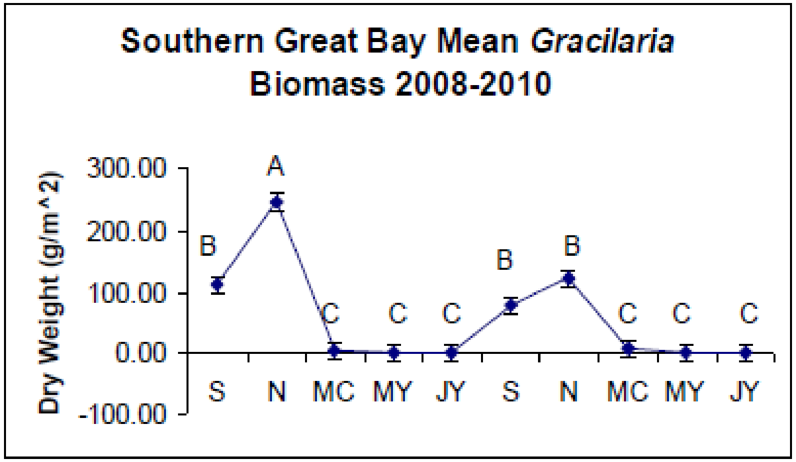


Figure 12 Southern Great Bay *Gracilaria* monthly mean biomass from 2008-2010. The Cedar Point and Wagon Hill Farm sites were not included in these calculations due to absence of organisms.

"Although DIN has increased dramatically since 1976, tissue concentrations in Gracilaria have remained relatively stable."

Macroalgae growth (location/timing), in general, does not coincide with initial eelgrass growth (April – July).

Monitoring Macroalgae

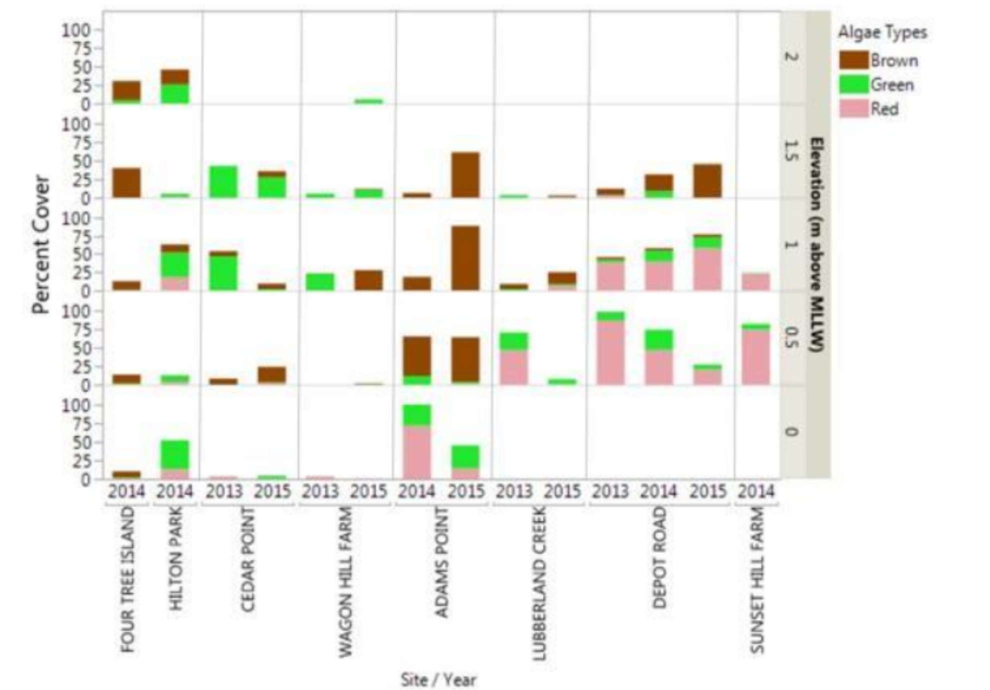


Figure 6. Cover of macroalgae at all sites sampled during three years and shown for each elevation, averaged over the three transects. Lowest sample elevation at Sunset Hill Farms was actually 0.75 m (not 0.5 m) above MLLW.

Measurements made in late August and early September.

Red algae (*Gracilaria*) mostly in Great Bay, accumulate at lower elevations (mudflats).

Green algae (*Ulva*) also in lower elevations of Great Bay.

Browns (*Fucoids*) not nuisance algae.

No dramatic increases in macroalgae in the Estuary from 2013 – 2015.

Indicates preference for non-eelgrass habitat (drier mudflats).

SeagrassNet Studies

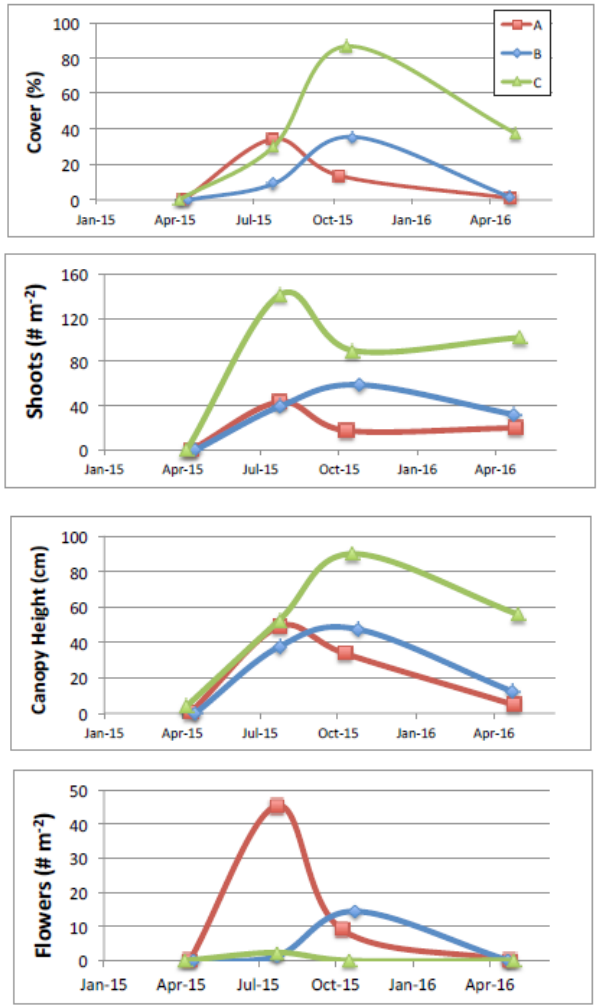


Figure 5. Eelgrass percent cover, shoot density, canopy height and flower density at SeagrassNet site NH9.2, Transects A, B, and C in Great Bay for April 2015 – April 2016.

SeagrassNet 2015 Results

Seaweeds generally begin growth later than eelgrass

Level of seaweed growth does not prevent eelgrass regrowth/ seedlings

Main area of competition is in the shallows where ice scour resets conditions

No evidence that epiphytes are a significant problem

Eelgrass Stressor Risk Summary

Light Transmission	
Phytoplankton	Low (conc. generally low, uniform)
CDOM/NAP/TSS	Low (Does not prevent eelgrass recovery)
Macroalgae	Low (Doesn't preclude eelgrass propagation during growing season– Track Invasive Species)
Epiphytes	Low (No problem Identified in SeagrassNet)
Nitrogen	Low (No correlation to plant growth or Kd)
Wasting Disease	High
Geese	High
Severe Weather	High
Ice Scour	High
Temperature	Medium (May be a future issue)
Sediment	Medium (Habitat alteration post-2006?)

PREP

Piscataqua Region Estuaries Partnership

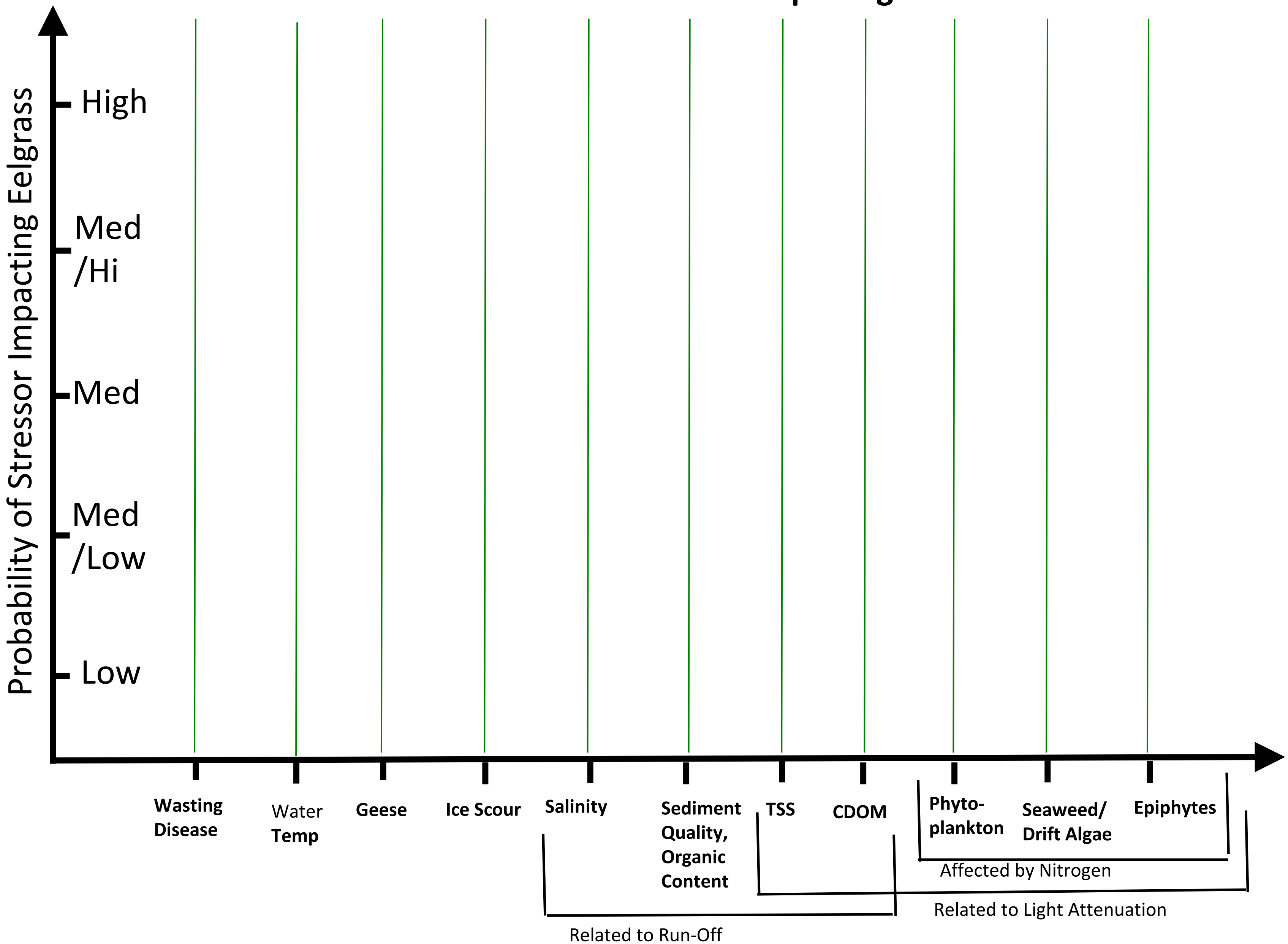
Technical Advisory Committee Meeting
May 10, 2017
Discussion Notes

Basic Agenda for Wednesday, May 10
Day 2

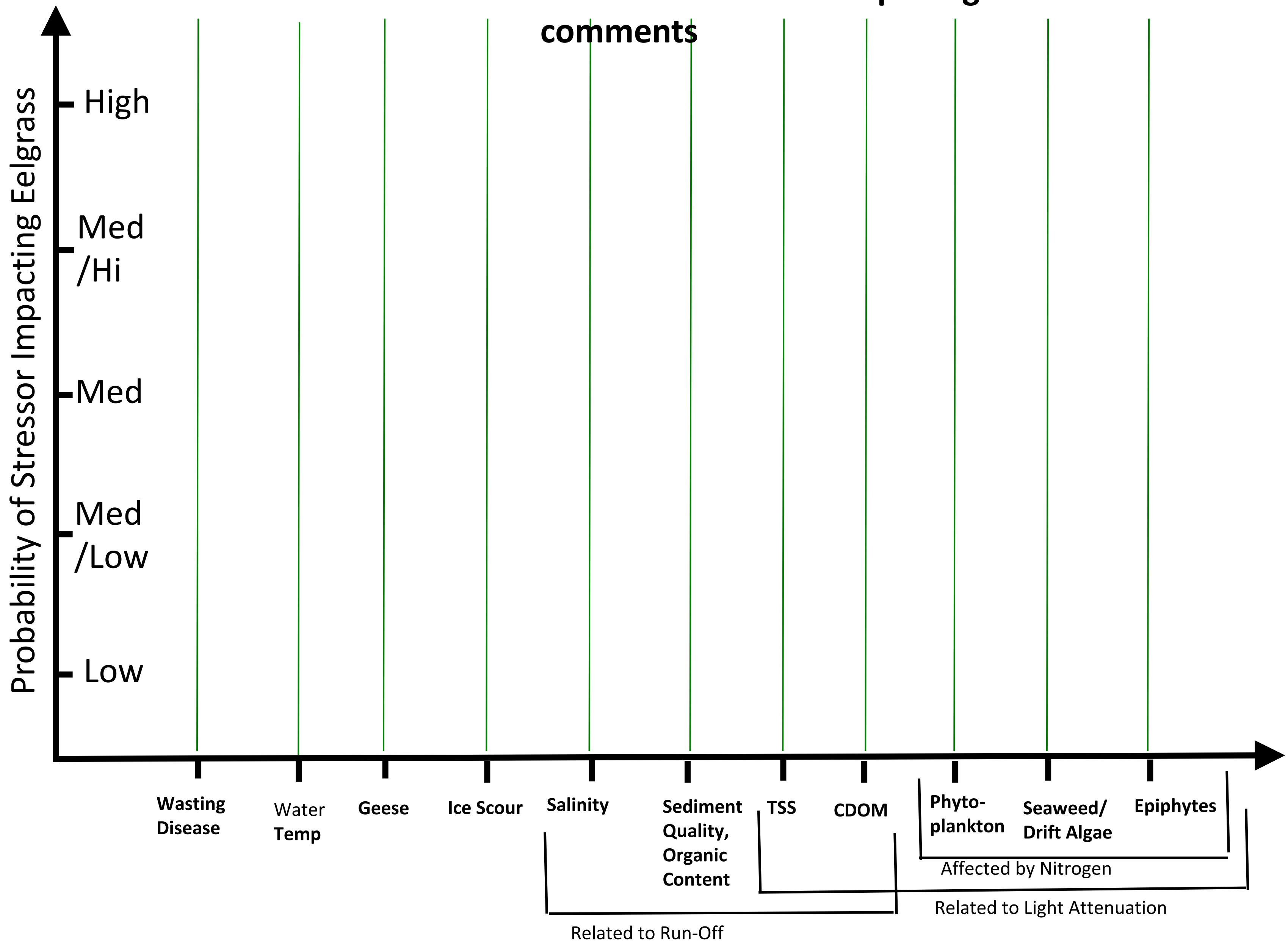
- Discuss matrix set up and purpose
- Take individual time to work on individual matrices
- Opportunity for people to discuss main points of their matrix

PREP
Piscataqua Region Estuaries Partnership

MATRIX TOOL: Opening Comments

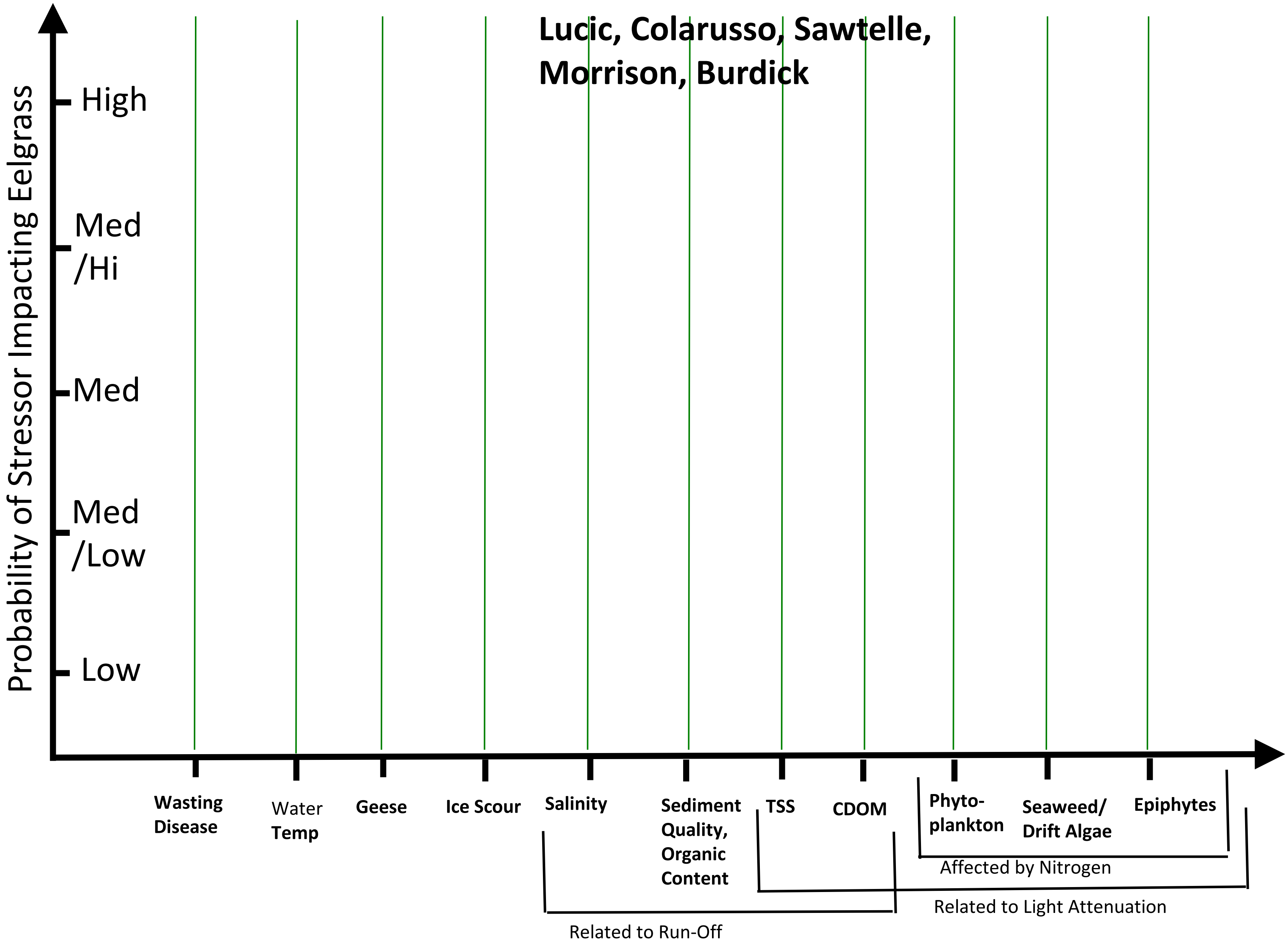


MATRIX TOOL: More opening comments



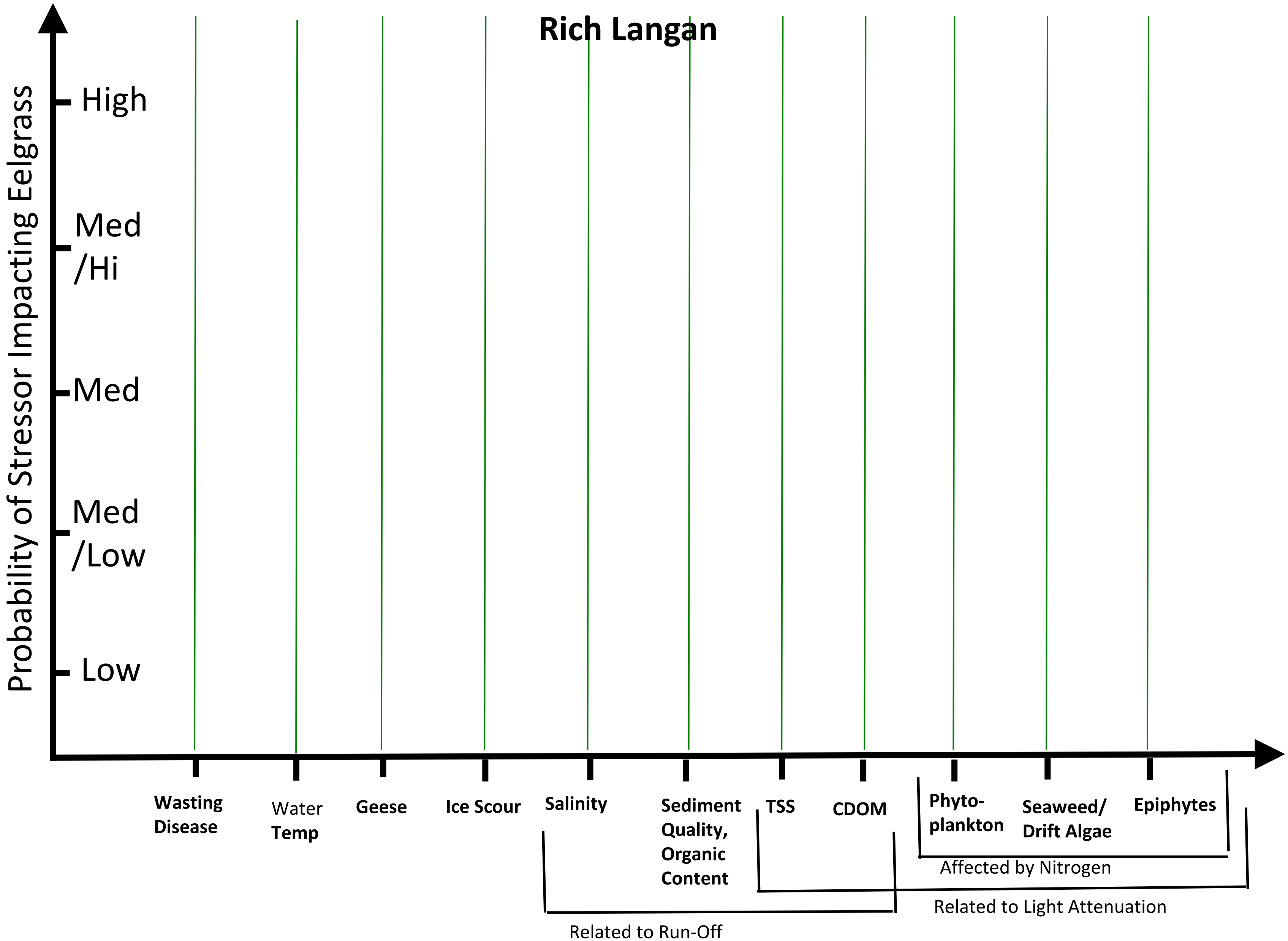
Blank Matrix for General Reference

MATRIX TOOL: Comments from Lucic, Colarusso, Sawtelle, Morrison, Burdick



Blank Matrix for General Reference

MATRIX TOOL: Comments from Rich Langan



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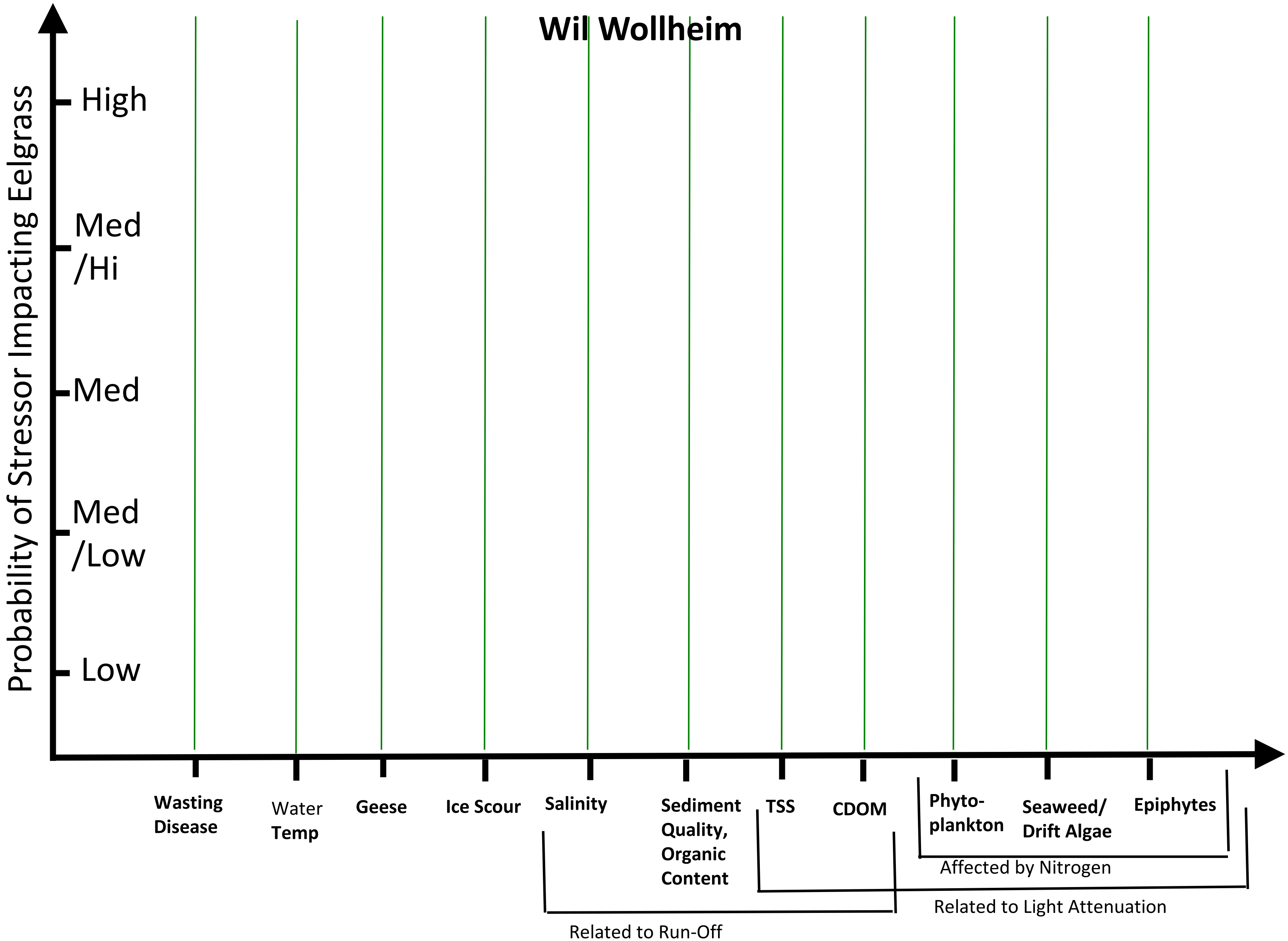
MATRIX TOOL: Comments from Wil Wollheim



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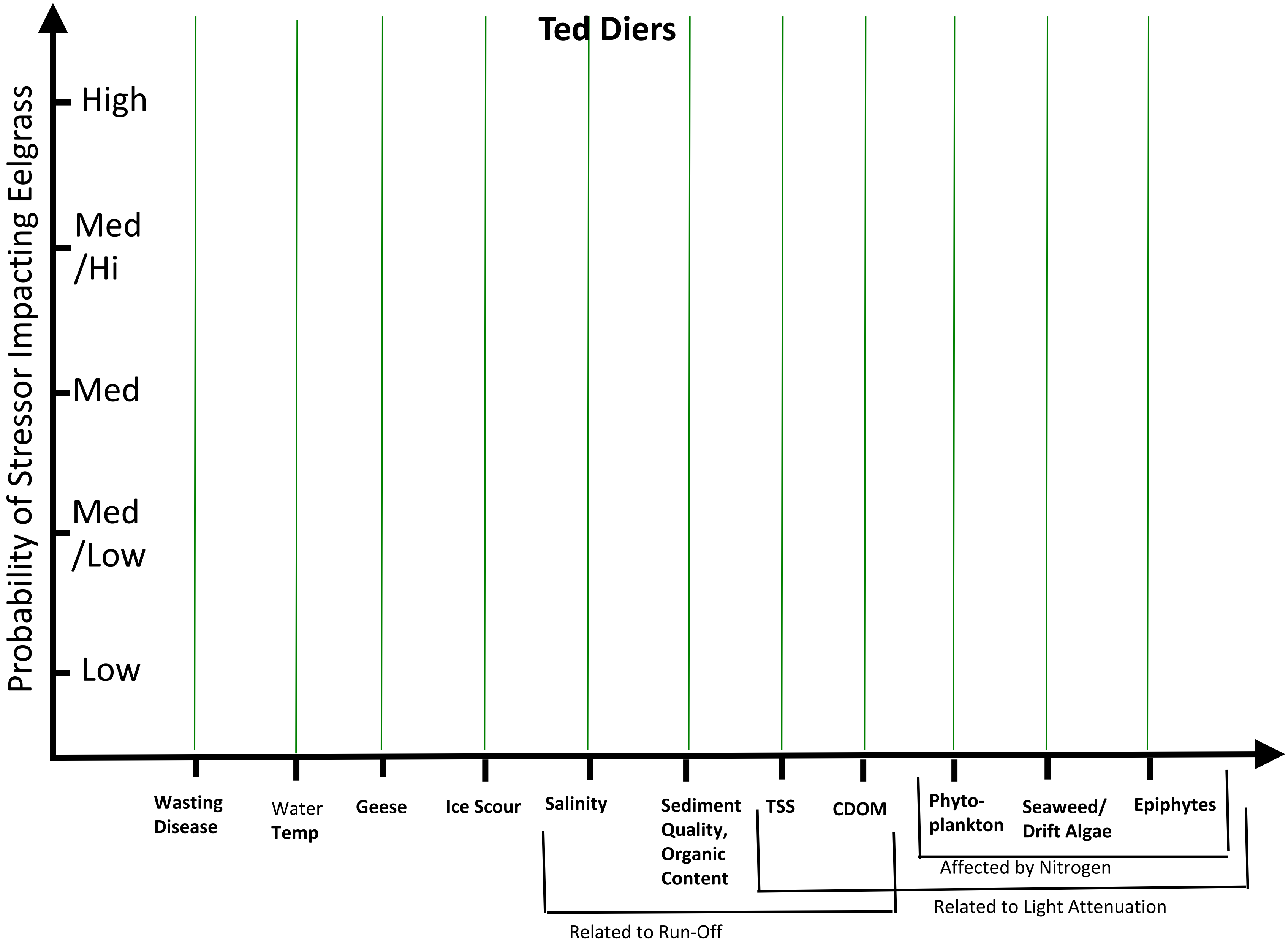
MATRIX TOOL: Comments from Ted Diers



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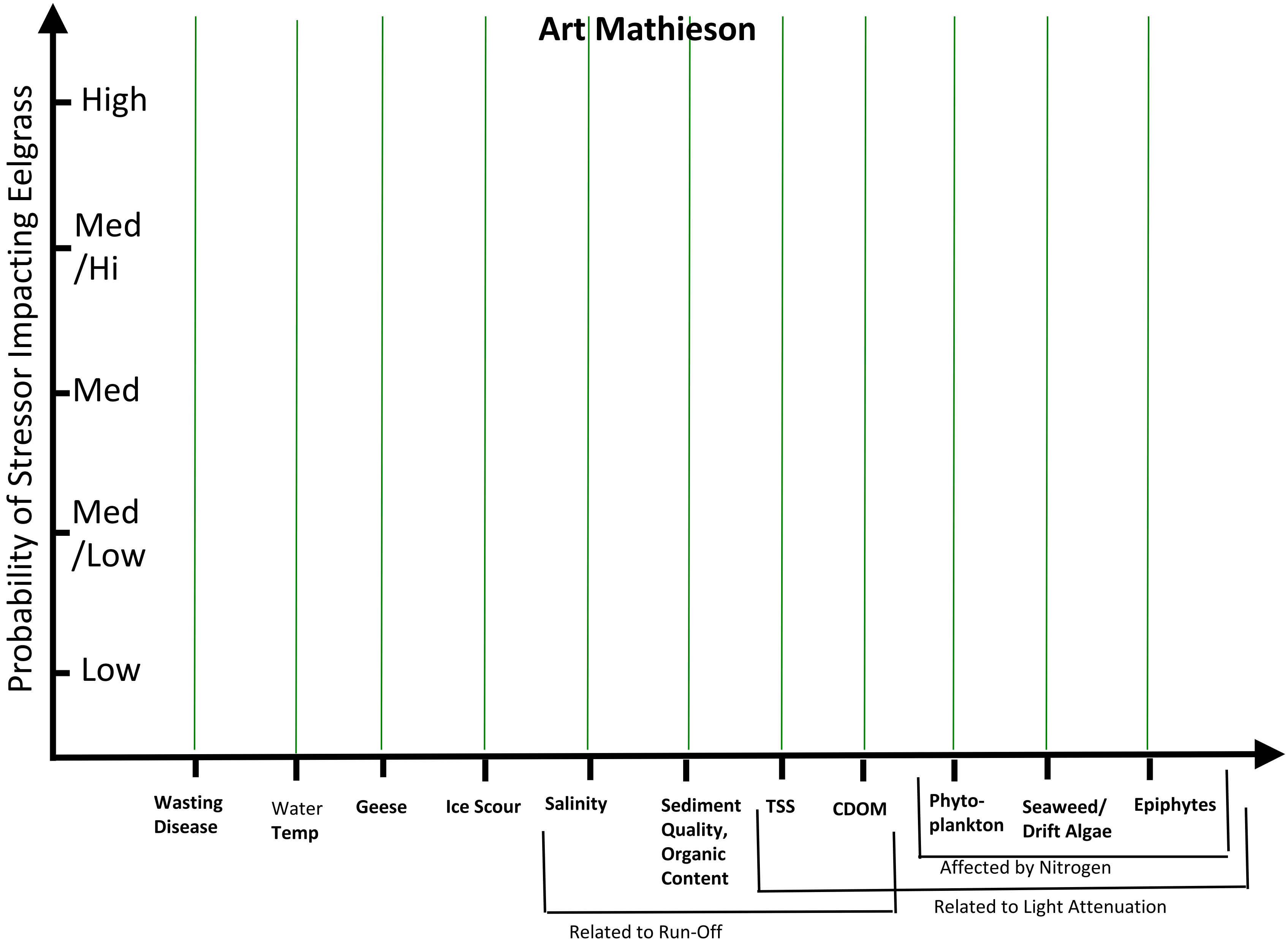
MATRIX TOOL: Comments from Art Mathieson



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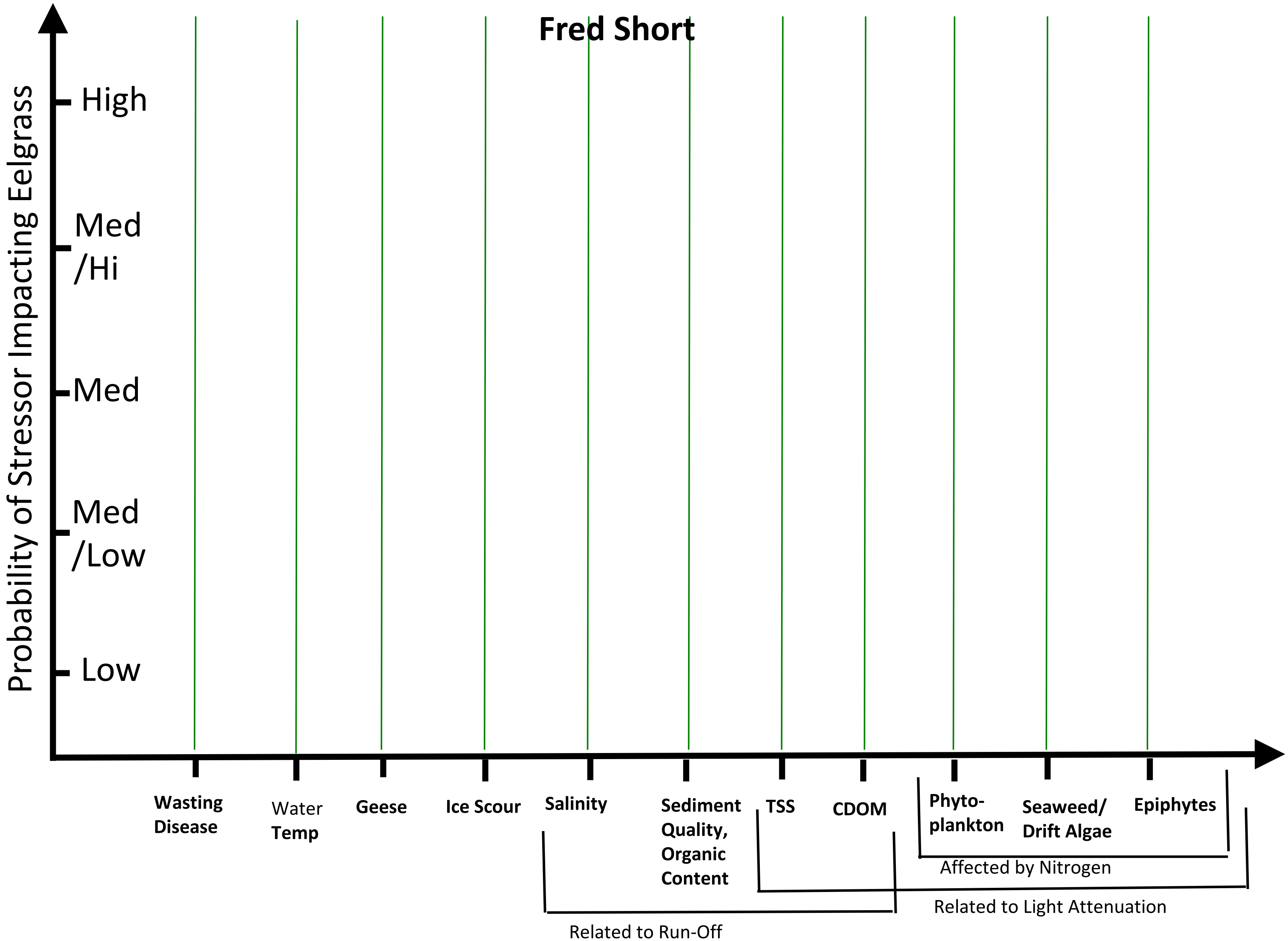
MATRIX TOOL: Comments from Fred Short



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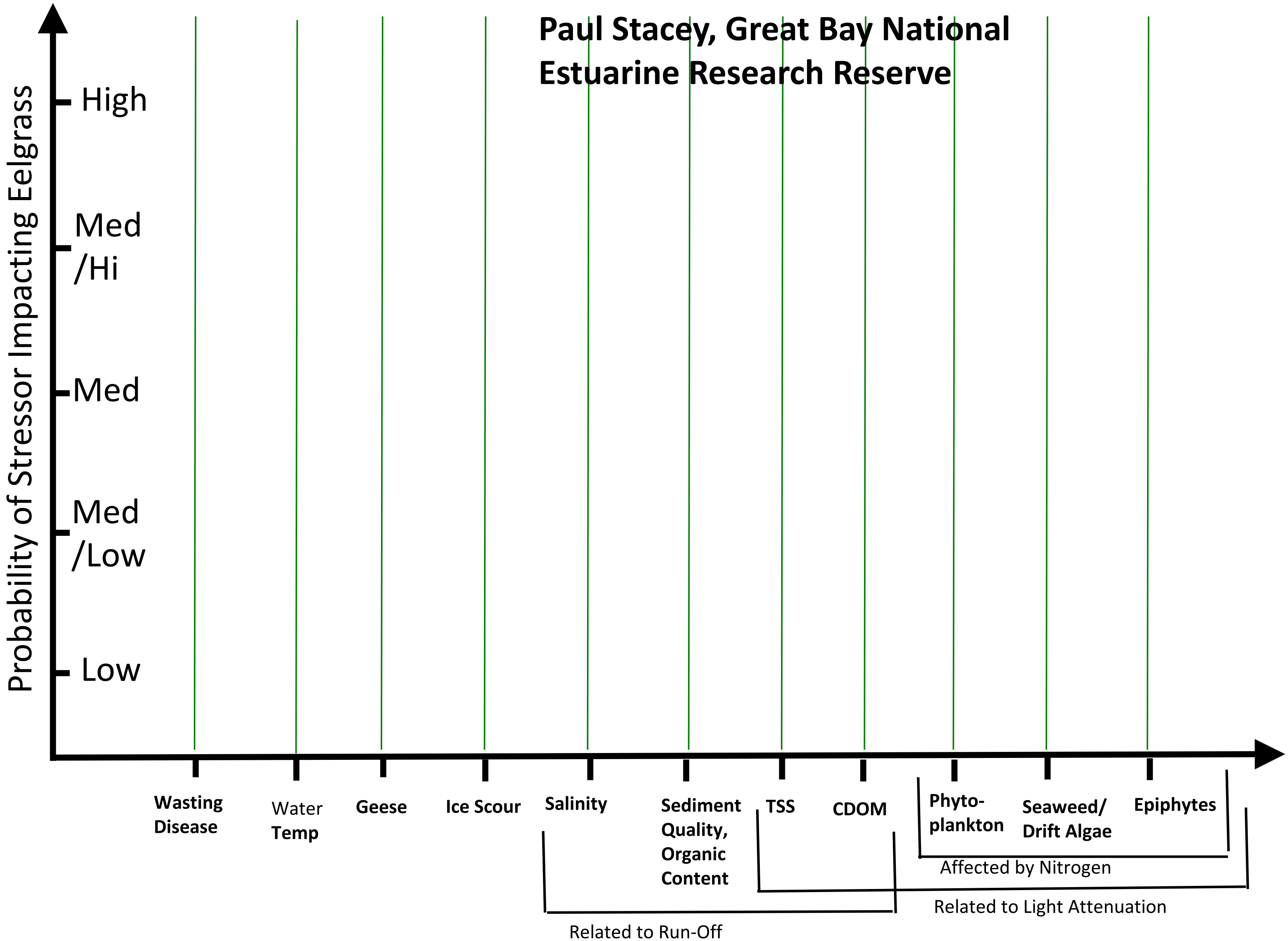
MATRIX TOOL: Comments from Ken Edwardson, NH DES

MATRIX TOOL: Comments from Paul Stacey, Great Bay National Estuarine Research Reserve



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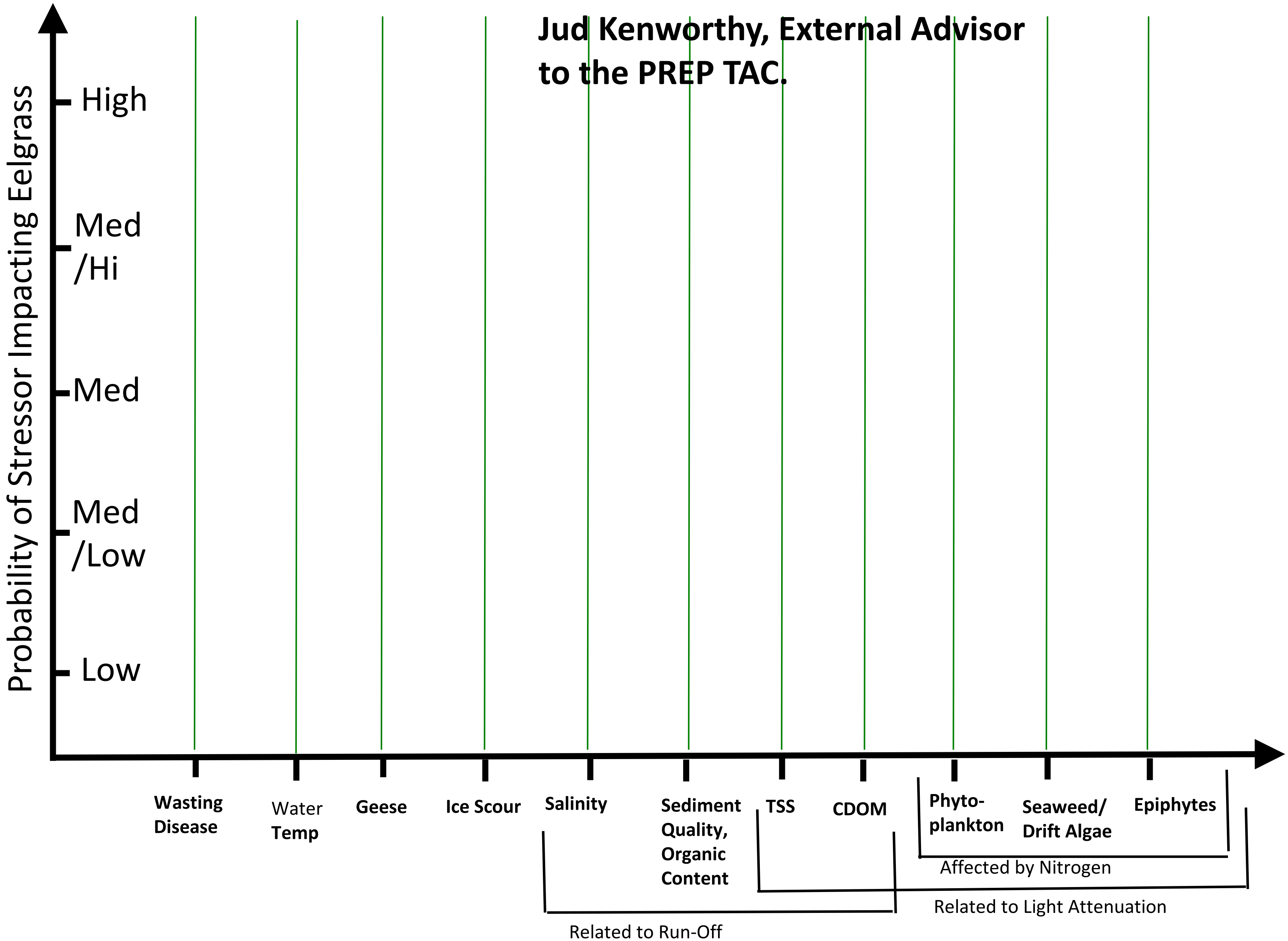
MATRIX TOOL: Comments from Jud Kenworthy, External Advisor to the PREP TAC.



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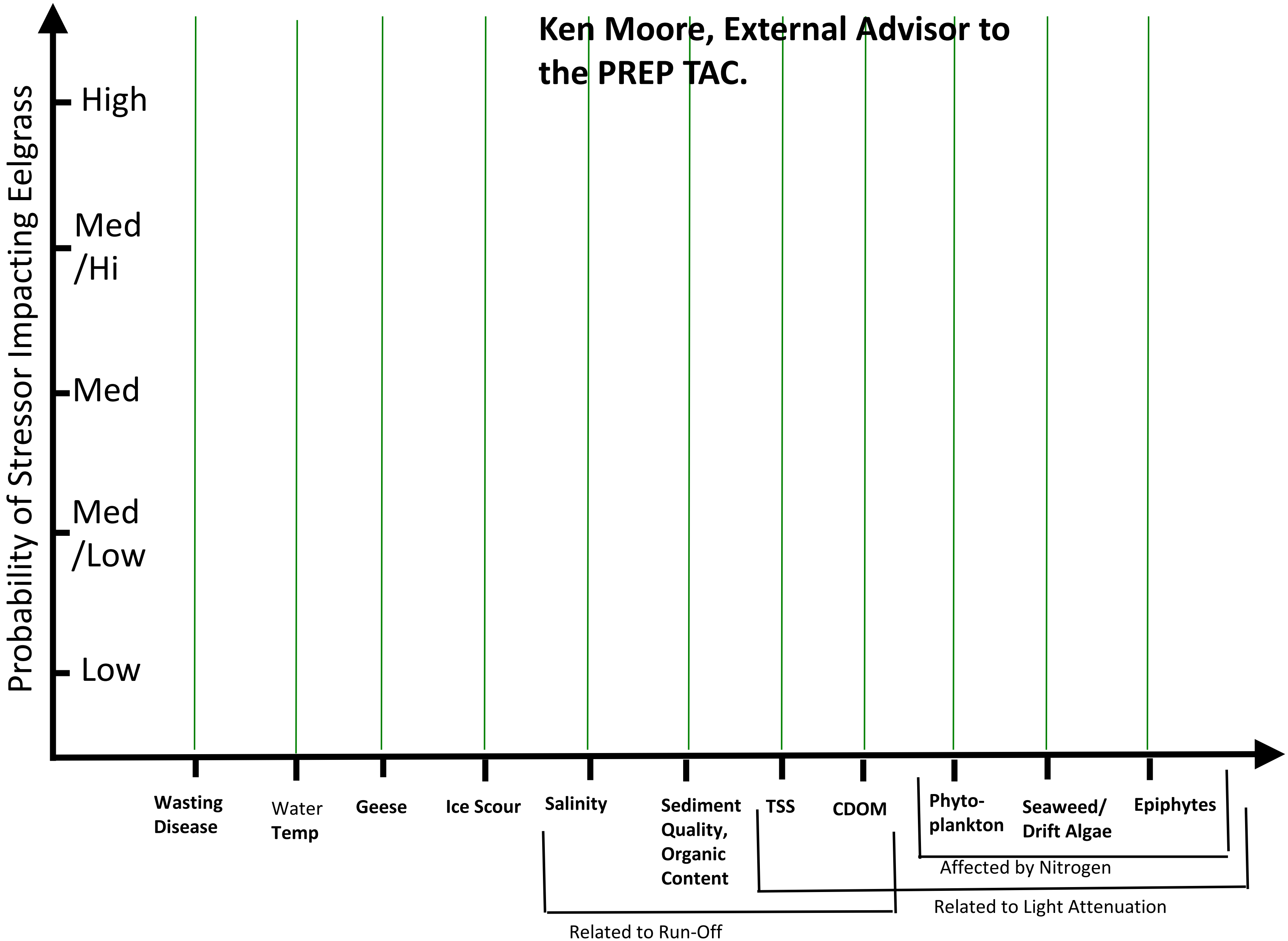

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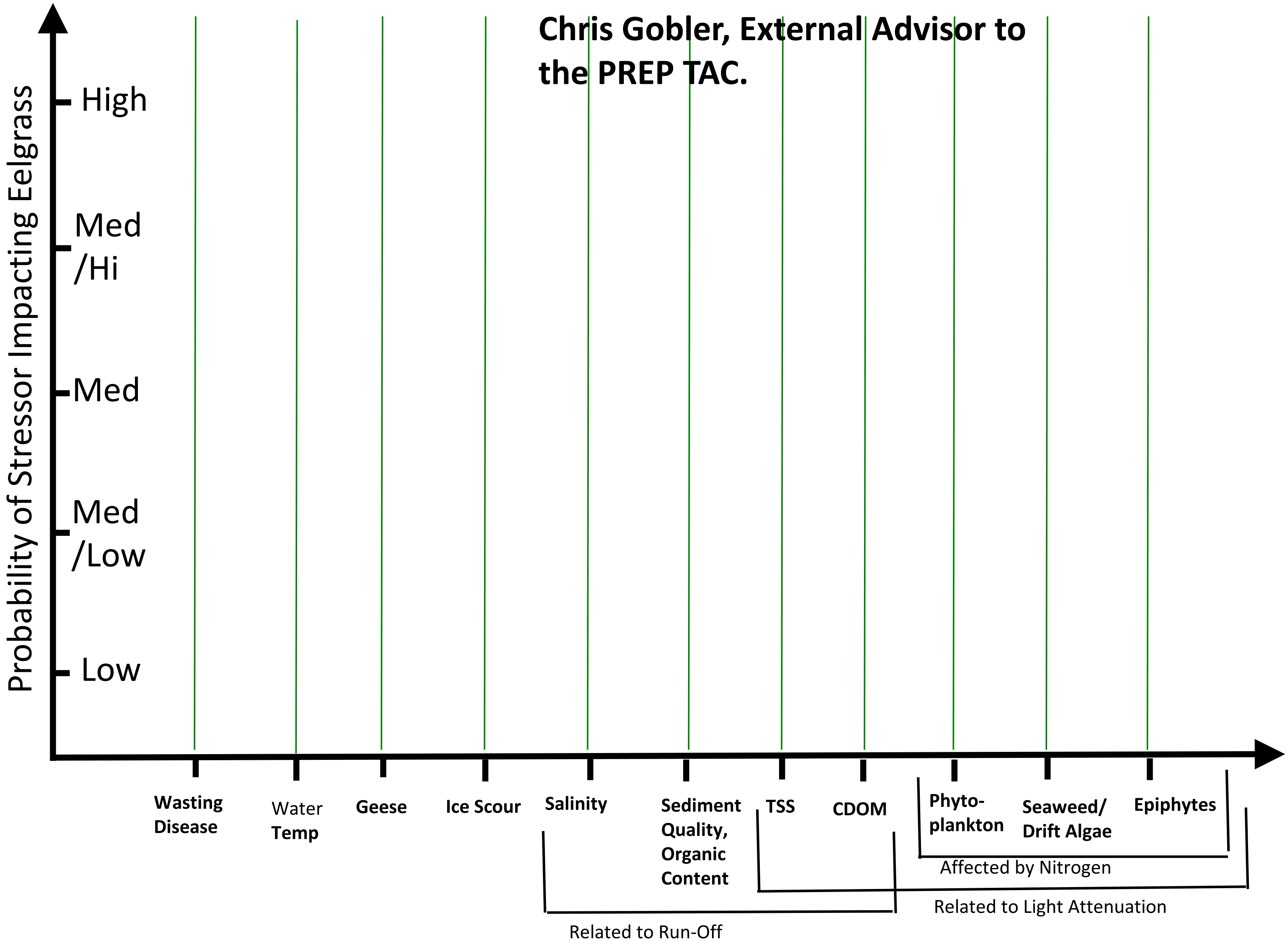
MATRIX TOOL: Comments from Chris Gobler, External Advisor to the PREP TAC.



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PREP

Piscataqua Region Estuaries Partnership

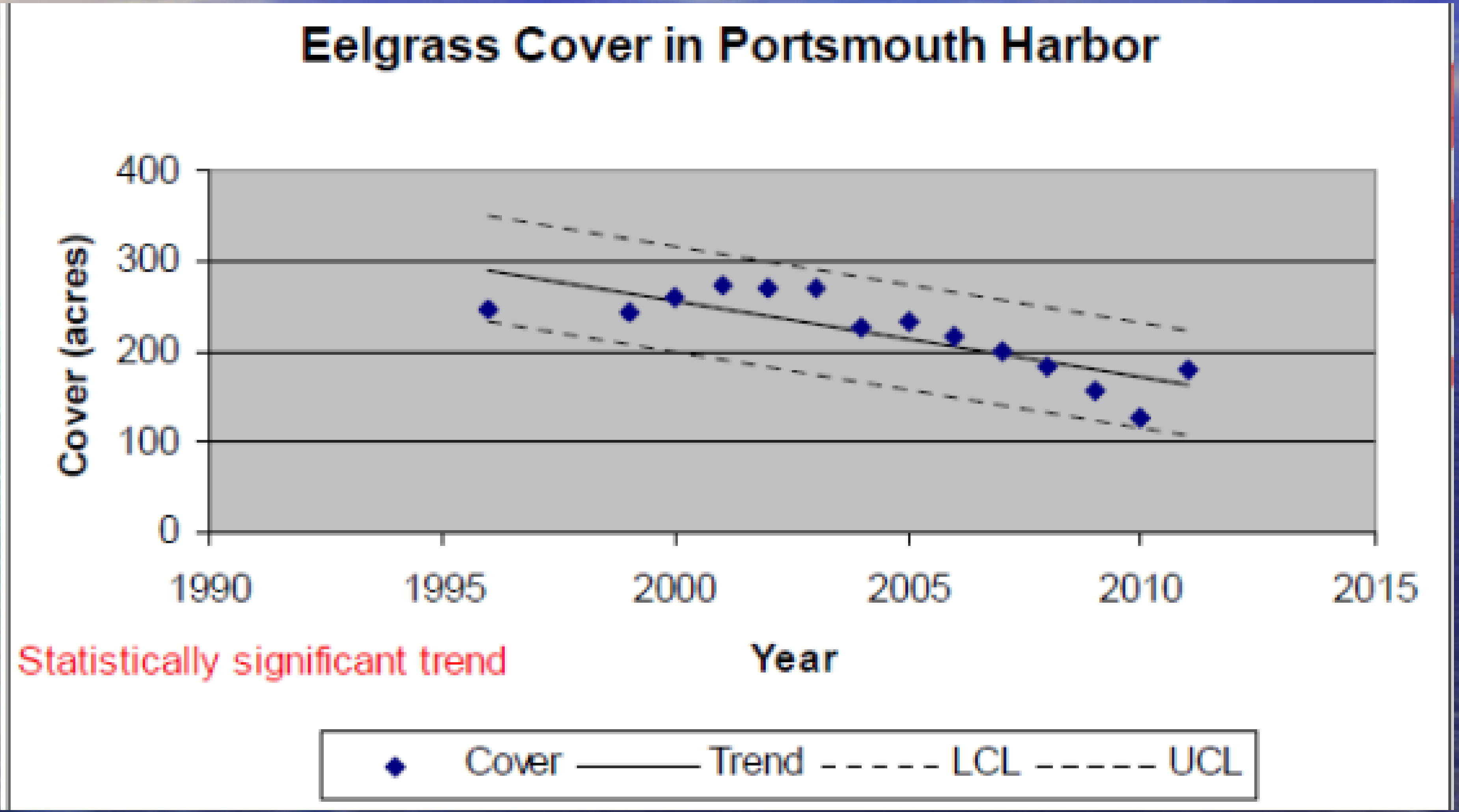
Notes
Final Discussion Segment (1)

PREP

Piscataqua Region Estuaries Partnership

Notes
Final Discussion Segment (2)

Notes
Final Discussion Segment (3)



Peconic Estuary – Orient Point

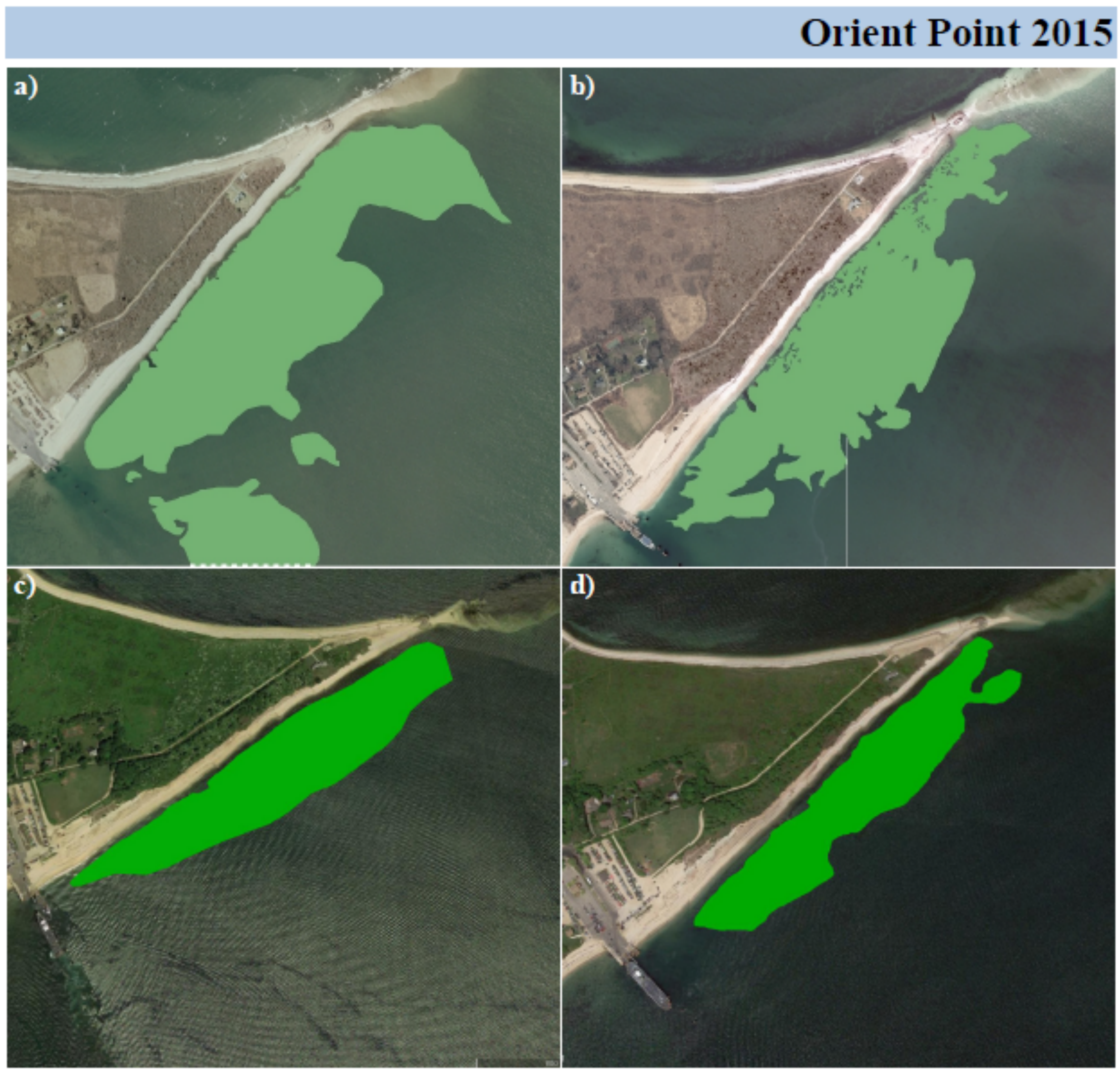


Figure OP-5. Delineations of the Orient Point, Southold, NY eelgrass meadow from aerial imagery for a) 2004, b) 2010, c) 2014 and d) 2015.

Peconic Estuary – Cedar Point

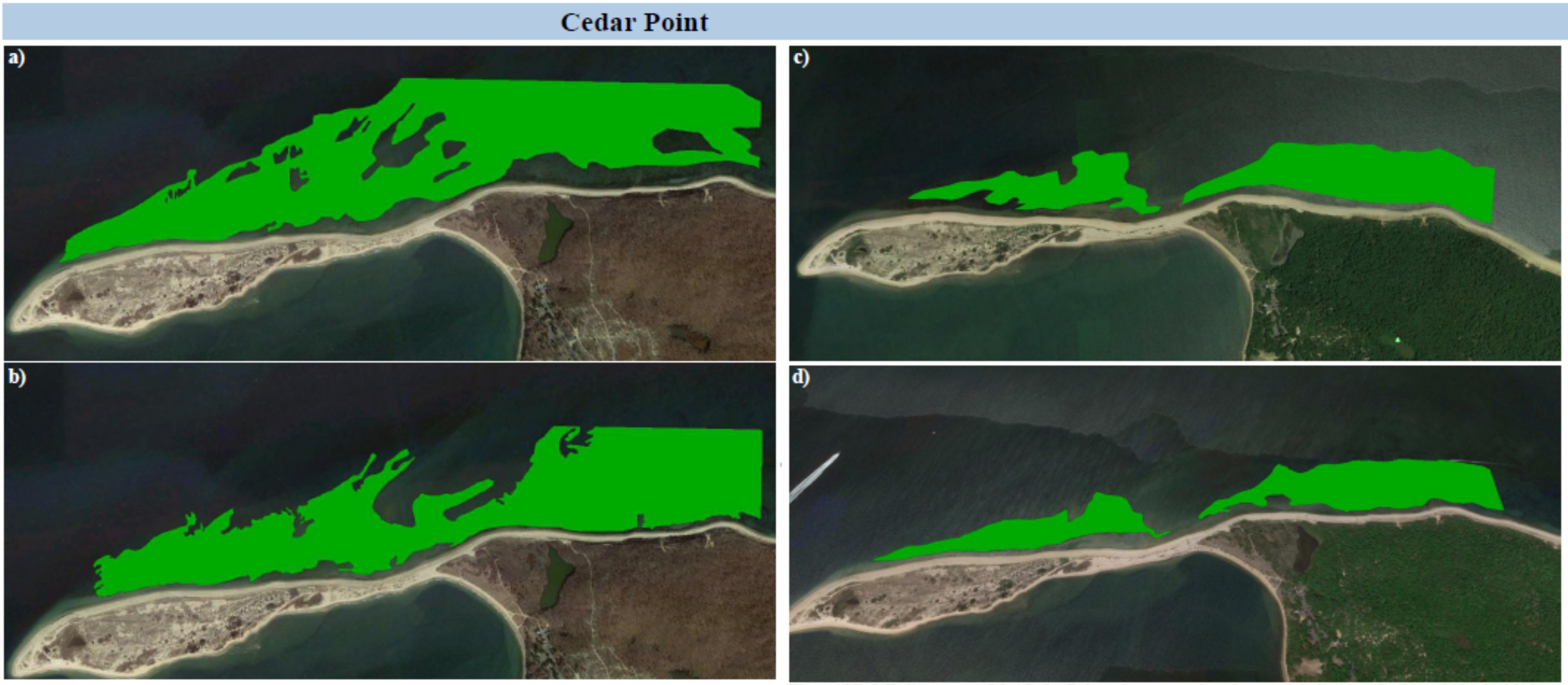


Figure CP-5. Delineations of the Cedar Point eelgrass meadow from aerial photographs for a) 2004, b) 2010, c) 2014, and d) 2015 (continued on next page).

What Does LI Data Show?

- Worse pattern of Eelgrass loss than in Great Bay with excellent WQ
- Timing similar to losses in Portsmouth Harbor
- Suggests biological agent at work?

PREP

Piscataqua Region Estuaries Partnership

Notes
Final Discussion Segment (3)

PREP

Piscataqua Region Estuaries Partnership

Notes
Final Discussion Segment (4)

Piscataqua Region Estuaries Partnership

Notes
Final Discussion Segment (4)

PREP

Piscataqua Region Estuaries Partnership

Notes
Final Discussion Segment (5)

PREP

Piscataqua Region Estuaries Partnership

CONCLUSION